THE UNIVERSITY OF ALBERTA

AN INVESTIGATION INTO THE RELATIONSHIP OF RHYTHMIC ABILITY AND READING ACHIEVEMENT

by

DULCE EVA GOULD

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE

OF MASTER OF EDUCATION

DEPARTMENT OF ELEMENTARY EDUCATION

EDMONTON, ALBERTA

MAY, 1966

UNIVERSITY OF ALBERTA

FACULTY OF GRADUATE STUDIES

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled "An Investigation into the Relationship of Rhythmic Ability and Reading Achievement," submitted by Dulce Eva Gould in partial fulfilment of the requirements for the degree of Master of Education.

ABSTRACT

This study attempted to determine whether "rhythmic ability"--defined as the ability to reproduce or match patterns of sounds, forms, or movements--was related to reading achievement, by examining children at two grade levels and at two levels of reading ability within each grade. The representative sample consisted of fifty children from each of the grades, one and three, selected on the basis of reading achievement and right lateral dominance, with an equal number of boys and girls from each grade and an equal number of children in each reading ability group. A battery of nine tests of rhythmic ability was selected, which included measures of auditory-motor, auditory-visual, and visual-motor ability, and tests of balance and of ability to reproduce regular and irregular sequences of movements. The tests of rhythmic ability, administered individually to all children by the investigator in May and June, 1965, were related to the results of city-wide reading tests, administered to each grade by the classroom teachers in June 1965, and to the results of group intelligence tests, which had been given to the children during their first term in grade one.

Testing revealed that grade three children were

superior to grade one children in rhythmic ability, although there was overlapping of scores on all tests. Correlation coefficients were computed, which determined that the relationship between rhythmic ability and reading achievement was higher at the grade one level than at the grade three level; in both grades, rhythmic ability was more closely related to reading and arithmetic achievement than to scores from printing or writing, physical education, or intelligence tests.

Comparison within the grades, of the means for rhythmic ability tests, indicated that good readers and poor readers in grade one differed significantly from each other in more aspects of rhythmic ability than did the reading groups in grade three. There was, however, a significant difference between the intelligence of the grade one groups, whereas the intelligence of the grade three groups was similar. In each grade, tests of auditory perception discriminated most effectively between good and poor readers and had the highest correlation with reading tests scores.

In comparisons made between the grades, the high and low reading groups in grade three were superior to the corresponding groups in grade one in at least six of the rhythmic abilities examined. However, the performances of the poor readers in grade three were

not significantly different, except in one visual-motor task, from the good readers in grade one.

The only significant sex-linked difference, in the abilities that were examined, was found in jumping skills, in which the girls at both grade levels were superior to the boys.

The results of this study suggested that certain rhythmic abilities, particularly those related to auditory perception, have significance for success in reading and may be useful for predicting or diagnosing problems. The conclusion that the ability to recognize and respond to patterns appeared to be more closely related to reading in the first grade has implications for reading readiness programs.

The writer wishes to express her appreciation to Dr. Marion D. Jenkinson for her continued interest and guidance. Appreciation is extended to the members of the committee. To Mr. Mervyn Wahlstrom, thanks is extended for assistance in programming the statistics.

The writer wishes to acknowledge, with thanks, the co-operation of the Edmonton Public School Board, in permitting this study to be carried out in the schools.

TABLE OF CONTENTS

PAGE

LIST OF TABLES

CHAPTER I

THE PROBLEM

INTRODUCTION TO THE PROBLEM

Research on reading readiness has demonstrated that many demands were made on the young child in his first encounter with formal learning. In addition to recognizing word forms and attaching meaning to them an appreciation of the importance of the order of the symbols and sounds in words has to be acquired.

The relationship between rhythmic ability and the awareness of order or sequence has been the subject of some speculation. Vernon (1957) stated that the ability to copy rhythmic tapped patterns might be related to the ability to associate letter and sound patterns. Kephart suggested that lack of integration between various sensory motor areas might result in limited ability to reproduce rhythmic patterns, and that this in turn might be related to poor auditory memory and/or appreciation of temporal order (1960, p. 235).

If this relationship were established, measures of rhythmic ability would have special significance for teachers who conducted reading readiness programs and who wished to identify children with potential reading problems.

BACKGROUND OF THE PROBLEM

Rhythm became the subject of both introspective and scientific investigation early in this century. Ruchmich (1913 and 1918), who compiled an extensive bibliography on rhythm, commented that his task was made increasingly difficult through the lack of consistency in defining the term and the diversity of subject fields which included rhythm in their studies. However, with the development of psychology as a science, investigators became more precise in their use and interpretation of the term.

Psychologists, particularly workers in the field of music, attempted to explain the nature of rhythmic behavior within the framework of various theoretical backgrounds. Lundin (1953) grouped theories of rhythm under three major headings: (1) instinctive, (2) physiological, and (3) motor. The theory that rhythm was an instinctive tendency to group impressions in order to obtain pleasure and efficiency was expressed by Seashore (1938). Seashore also distinguished between "subjective rhythm" in which the subject organized single unaccented beats into patterns, and "objective rhythm" in which the organization of the pattern was externally imposed. Physiological theorists claimed that awareness of rhythm depended on inner references such as breathing, heart beat, and other bodily processes. Lundin (1953) supported what he termed the

motor theory--that rhythm was a perceptual-motor response which demanded perceptual organization and differentiation of stimuli and which involved the whole organism. Supporters of the "instinctive" theory did not believe that rhythm could be trained, but other theorists considered it a learned response.

Rhythm has been absorbed into the field of general psychology as a form of perception or perceptual-motor behavior. Hilgard (1957) stated that, although attention had been focussed mainly on visual perception, the Gestalt Laws of primitive organization applied to other sensory fields also. Thus rhythm was sometimes spoken of as "figure ground for form in the dimension of time" (Kephart, 1960, p. 235).

Accepting rhythmic behavior as a perceptual-motor response would imply that improvement could be brought about by training, as experience modifies perception (Morgan, 1960). The co-operation of different senses might also alter perception, according to Morgan, who said, "What one hears, for example, affects what one sees, and impulses from the muscle sense can alter one's visual perception" (1960, p. 331). This principle appeared basic to remedial reading procedures which used combined sensory techniques to correct and train children's perceptions of shapes and/or sounds (Frostig, 1964; Gillingham, 1960),

and others).

Vernon, referring to the cognitive difficulties of backward readers, said:

> The one universal characteristic of non-readers suffering from specific reading disability is their complete failure to analyse word shapes and sounds systematically and associate them together correctly (1957, p. 74).

The work of Bryant (1964) implied that the inability of some children to associate sequences of sounds and letters might be due to difficulties with spatial and temporal organizations. Although Monroe (1932) considered that problems with letter orientation and sequencing might arise from separate causes, De Hirsch (1963) observed that children with specific reading disability tended to be poor in patterning their responses in all sensory areas. The work of Lashley (1951), by suggesting that problems with serial order arose from a more general weakness in organization at a higher level of brain functioning, rather than stemming from specific defects, appeared to support De Hirsch's observations.

The symptoms exhibited by non-readers have been noted, to a lesser degree, in many backward readers. Vernon observed that these deficiencies seemed "to be confined solely to linguistic activity", but some recent research has suggested that the problems discussed above might be identified by examining the young child's

ability to integrate information of a non-linguistic nature.

Birch and Belmont (1964) hypothesized that the ability to integrate stimuli received from different sense modalities might be a prerequisite for learning to read, thus having more significance for learning at the younger age levels. Kephart (1960) considered that the child must be able to translate information organized in space into a temporal organization, and the converse, if he were to develop adequate word recognition and spelling skills. The development of an appreciation of temporal order, according to Kephart, proceeded through three stages: (1) an awareness of simultaneity in sounds and actions, (2) development of the ability to recognize and evaluate temporal intervals (rhythm), and (3) the development of ability to order events in time (sequencing) using stage two for reference (1964, pp. 205-206). The proposal was put forward (Kephart, 1960, 1964) that sequencing ability might develop through perceptual-motor experience in which kinaesthetic, tactile, and auditory rhythms were integrated; through this integration stable and consistent relationships would be available which could be generalized and applied to varied events.

Research which related rhythmic and sequencing ability to reading achievement appeared limited to studies

by Birch and Belmont (1964 and 1965), Stambak, as cited in Vernon (1957, p. 62), and Carton, as cited in Godfrey (1964c, p. 5). Visual or motor responses to auditory rhythms only were examined in these studies.

There appeared to be merit in further examination of the ability of children to respond to patterns of sounds, movements, and forms organized in time or space using the medium of rhythmic and/or sequencing activities, and relating this ability to reading achievement and other school subjects. A comparative study was planned, therefore, to determine whether differences in rhythmic ability existed between children of different ages and at different reading levels and to ascertain whether the proposed relationship between rhythmic ability and reading achievement could be supported.

PURPOSE OF THE STUDY

The purpose of this study is to investigate the possibility that rhythmic ability (as defined in the study) bears a relationship to reading achievement at two grade levels--grade one and grade three. The sample will include children of good and poor reading ability from each of these grades. A battery of rhythmic ability tests will be administered to the children individually. Comparisons will be made between the test performances

to determine whether differences in rhythmic ability exist between total grades, between reading ability groups within each grade, and between corresponding reading ability groups in each grade. The possibility that reading and rhythmic ability are related will be investigated further by examining the relationship of test scores which measure ability in these areas.

HYPOTHESES

In order to investigate the nature of rhythmic ability at the different grade levels and levels of reading ability, the following hypotheses will be tested:

I. There is no significant difference in the rhythmic ability of grade one children and the rhythmic ability of grade three children.

II. There is no significant difference in rhythmic ability between the following groups of children:
  a) a high reading ability group and a low reading ability group at the grade one level;
  b) a high reading ability group and a low reading ability group at the grade three level;
  c) a high reading ability group in grade one and a high reading ability group in grade three;
  d) a low reading ability group in grade one and a low reading ability group in grade three;
  e) a high reading ability group in grade one and a low reading ability group in grade three.

III. The relationship between rhythmic ability and reading achievement at the grade one level will not differ from the relationship observed between these abilities at the grade three level.

IV. There will be no significant sex differences in rhythmic ability at the grade one level or at the grade three level.

ASSUMPTIONS

The investigation was based on the following assumptions:

1. That the instruments which were used for testing rhythmic ability gave reliable and valid measures of that ability.
2. That the evaluation of a child's responses by a single examiner gave a reliable estimate of his rhythmic ability.
3. That the reading test scores and the grading of other school subjects by the classroom teacher were reliable indications of ability in those subjects.

DESIGN OF THE STUDY

The Sample

A representative sample of right-handed, right-eyed children in low and high reading ability groups in grades one and three, was selected from a total school enrolment of between 85 and 110 children in each grade in each of three elementary schools in the city of Edmonton, Alberta. The preliminary selection of the children on the basis of reading ability, made by the classroom teacher, was verified by the investigator by referring to the results of city-wide reading tests which were

administered in June 1965, by the classroom teacher. Screening for dominance was carried out by the investigator prior to the final selection of pupils. The decision to restrict the sample to children with right lateral dominance was made in an effort to eliminate laterality as a variable in the study. Information concerning intelligence test scores, gradings in school subjects, and reading test scores was obtained from the school records.

Procedure

1. A pilot study was conducted in one of the three schools available for the study, before beginning the research testing program. The purpose of the pilot study was to assess the suitability of the tests, and, with the aid of an outside observer, to refine testing procedures.
2. Tests for right lateral dominance were administered to all children who were eligible for inclusion in the sample. Only those children who showed a preference for their right hand and who used their right eye for sighting were selected.
3. Tests which had been selected by the investigator as being measures of rhythmic ability were administered individually by the investigator to all children in the sample, during May and June 1965.

4. All data was recorded and punched on I.B.M. cards. Statistical treatment was determined; processing was carried out at the Computing Centre, University of Alberta, Edmonton.
5. The results of the statistical treatment were analyzed by the investigator.

Analysis of Data

1. The differences between the means for all tests for total grades, and for reading ability groups within and between the grades were computed.
2. Correlations between test scores for general abilities and rhythmic abilities were computed for each grade and group.
3. Tests of significance were carried out on t-scores and correlation coefficients.

DEFINITION OF TERMS

Rhythmic Ability

For the purpose of this study, rhythmic ability refers to the ability to reproduce or match patterns of sounds, forms, or movements, as measured by the tests in the study.

Auditory-Motor Ability

The term "auditory-motor ability" refers to the

ability to reproduce an auditory pattern (a pattern of sounds) by using a motor response (a series of tapping movements) as measured by the test used in the study.

Auditory-Visual Integration

The term "auditory-visual integration" refers to the ability to match an auditory pattern (a pattern of sounds) with a visual pattern (a pattern of dots) as measured by the test used in this study.

Visual-Motor Ability

The term "visual-motor ability" refers to the ability to reproduce a visual pattern (a pattern of shapes) or mental image (memory of pattern) by using a motor response (a series of co-ordinated movements) as measured by the tests used in the study.

High Reading Ability Group

The group of children in each grade who have been judged on the basis of teacher rating and reading tests given in June 1965, to have made highly satisfactory progress in learning to read, is referred to as "high reading ability group".

Low Reading Ability Group

The group of children in each grade who have been judged on the basis of teacher rating and the results of

reading tests given in June 1965, to have made below average progress in learning to read, is referred to as "low reading ability group".

General Abilities

The term "general abilities" refers to achievement or ability measured by reading, arithmetic, printing or writing, physical education, and intelligence tests, and the total rhythmic ability test battery.

LIMITATIONS OF THIS STUDY

The following limitations of the study were recognized:

1. Attempts to measure rhythmic ability by using different sensory combinations were limited to single tests in a limited number of combinations, with the exception of visual-motor ability in which four tests were used.
2. No attempt was made to estimate the effect of previous training or experience on the rhythmic performances of the children.
3. The study proceeded in full awareness that problems existed when evaluating children's movements--problems of subjective bias and inadequate measures. However, it was felt that use of diagnostic procedures, devised by specialists for

problem learners, demanded that the reading clinician should be familiar with the range of behaviors presented by both good and poor readers.

4. Some adaptation of tests was necessary; this reduced the value of the study in that the results of adapted tests could not be compared with the findings from the original tests. However, any changes which were recorded so that comparisons could be made where appropriate.
5. No attempt was made to study abilities other than rhythmic ability, although others might have been incorporated into the original test designs.
6. No attempt was made to analyse the types of reading skills which were examined in the tests of reading ability.
7. No attempt was made to measure memory span as such. Although Birch and Belmont (1964) found that auditory-memory span was not related to the auditory-visual integration performance, some writers have suggested that rhythmic ability may have a relationship with memory for temporal sequences. Test designers have found that grouping of stimuli aids immediate memory (Wells and Ruesch, 1945). All of the tests used in the rhythm battery were assumed to measure the ability to group

responses and thus served as measures of visual, auditory, and motor memory. However memory was not examined as a factor in the performances.

8. No attempt was made to establish the reliability and validity of the tests which were used to measure rhythmic ability.

NEED FOR THIS STUDY

The beginning reader may have a limited awareness of order in both spatial and temporal fields, but he appears, through maturity and learning, to develop this ability quite satisfactorily. The poor reader, for a number of reasons, may fail to do so. Improved techniques are needed to aid educators to identify the degree of difficulty a child has in performing ordered actions. Research is needed to determine whether a disability in this area is a significant factor in causing poor progress in reading.

If rhythmic ability bears a relationship to reading achievement an attempt should be made in kindergarten and grade one to identify children who are deficient in this area. Appropriate training procedures might then be instigated to alleviate the condition within the limits set by health, neurological, and other physical factors. It appears possible that only a minimum level of ability

is required but that children who are below this level may be handicapped in learning. School programs which emphasize flexibility and adaptability in physical education classes, writing, music, art and handwork help children develop movement patterns which contribute to their general efficiency. By examining the ability of children to regulate their movements according to predetermined patterns, it was hoped in this study to clarify the relationship of rhythmic ability to academic achievement and to identify effective methods for measuring rhythmic ability.

ORGANIZATION OF THE REPORT

In Chapter I the problem was identified and discussed. Research studies and literature related to the problem are presented in Chapter II. Chapter III describes the methods for selecting the sample, the testing instruments and procedures, the pilot study and the statistical treatment of the data. The results of the statistical analysis are reported and interpreted in Chapter IV. The conclusions based on the findings, together with the implications for teaching, are then presented in Chapter V.

CHAPTER II

A REVIEW OF RELATED RESEARCH

This chapter will deal with findings from research on rhythmic ability which have bearing on the reasons for examining or training this ability in young children, and on methods and techniques for measuring rhythmic ability. An indication of the breadth of the field will be given by examining research in music, handwriting, reading, and motor skills. Studies which have implications for the consideration of rhythmic ability as a possible measure of "readiness" to learn will be given more detailed attention.

RHYTHMIC ABILITY IN MUSIC

Musicians assumed that rhythm was a facet of musical ability and included rhythm tests in most tests of musical aptitude. However these tests had low validity and reliability when compared with each other, with other tests in the music batteries, and with retests of the same subjects--usually older children or adults (Farnsworth, 1931, as cited in Lundin, 1953). The <u>Seashore Measures of Musical Talents</u> (Seashore, 1938) included a rhythm test which was used frequently in studies not directly connected with music (Karlin, 1942; Guilford, 1957; Beard,

1965). In the Seashore test, pairs of recorded rhythmic patterns (non-musical clicks) were played to the subject who selected the matching rhythms. The same principle was used in other rhythm tests although in some cases a melody was added. Such tests seemed to be measuring rhythmic discrimination and possibly, auditory memory span, rather than the ability to make rhythmic responses. A study by Smith (1957) found that rhythmic discrimination and motor rhythm responses were significantly related. However this study was too limited in scope to be able to draw firm conclusions from it about this relationship.

Studies of children's responses to rhythm in music have focussed on: (1) the ability to keep time to music, (2) the rate and degree of improvement with age and practice, and (3) the kinds of training which were appropriate.

The findings suggested that rhythmic responses were difficult to measure (Heinlein, cited in Lundin, 1953), that children made a fairly rapid gain in pre-school years in the ability to make rhythmic responses but profited little from training (Jersild and Bienstock, cited in Jersild, 1939a), that some gain was observed up to at least eight years of age (Williams, 1932; Pflederer, 1964).

Implications for training in rhythm were found in a study by Christianson (cited in Landreth, 1958), who

considered that training in rhythm should not focus on the ability to keep time but that children should be given many and varied opportunities to improvise their own rhythmic responses. Pflederer, however, stated that models were necessary "to sharpen the child's ability to discriminate between patterns", but agreed that a wide range of experience was necessary to establish a framework of reference. According to Pflederer an important implication of the rhythm tests administered in her study, was that overt interaction of the child--as in tapping, counting, or clapping--contributed to a more successful performance. Wight (1937) found that training in making rhythmic responses to music, of handicapped students between the ages of 5.7 and 15.7 years, resulted in improved performances by the experimental group when compared with a control group who had received no training. A significant correlation was found between rhythm and chronological age, and between rhythm and motor coordination. The investigator concluded that, whereas there were individual differences in ability to make rhythmic responses, this ability could be improved by specific and general training.

Perhaps the most interesting aspects of these studies were the observations made by the investigators. Heinlein felt that the examiner's subjective response to

the test rhythms might influence his evaluation of the child's response. Williams noted that children seemed to use auditory cues more than visual cues in the tapping tests, and that motivation and motor set were apparently significant factors in the performance of young children. Williams also commented that the promptness and ease of the performances by the superior children was outstanding. It appeared that being able to recognize and respond appropriately to rhythm contributed to a more relaxed and confident performance.

RHYTHMIC ABILITY IN HANDWRITING

Freeman (1939) cited studies by Freeman and Nutt and others, which agreed that writing became more rhythmical as the child matured. Although there were conflicting opinions about rhythm in writing (Herrick, 1960a), it seemed appropriate to examine this quality as it was conceived by Freeman. The rhythmic effect, according to Freeman, was gained through the writing of letters as wholes--the practised movements tending to be made in similar intervals of time.

However the ability of young children to make such movements might be limited according to evidence from studies on handwriting. Gesell (1946) noted that four and five year olds might use several strokes to make one

letter. The ability to make letters with one stroke usually appeared at age six in the population sample which Gesell examined, and refinements of the writing skill developed in succeeding years. One could conclude that the writing of letters as units or "wholes" was related to both maturation of perceptual-motor ability and practice.

An examination of writing practice and instruction procedures revealed that educators assumed that "rhythm" or rhythmic devices aided children in learning to write. A U.N.E.S.C.O. survey The Teaching of Handwriting (1948) found that syllabi from several parts of the world (including Alberta and Saskatchewan) prescribed various kinds of preparatory or training exercises in rhythmic movements. Herrick (1960b) found that eight out of nineteen commercial systems of handwriting advised rhythmic exercises. Much of the literature seemed to find the word "rhythmic" to be indispensible for describing the type of movement which was desirable, and Herrick (1960a), in another review of instructional procedures, commented that the only major characteristic which was common to all was the reliance upon rhythm and the rhythm count.

Herrick criticized this emphasis stating that it was not supported by research. He referred to a study by Irish who used timed procedures to examine adults'

handwriting (Herrick, 1960a). No evidence was found to support either a factor of rhythm or the use of rhythmic sayings or counts in instructional procedures. This position was reiterated at a recent conference on handwriting (Herrick, 1963); however, at this conference, Freeman proposed that there should be further research on such factors as posture, position, and movement which might affect the ability that is commonly called rhythm.

These factors had been used as criteria in diagnostic tests of perceptual-motor abilities, developed by Kephart (1960) to assess the problems of slow learners. The child's performance, while drawing simple lines and forms at a blackboard easel, was analysed in an effort to discover where his visual-motor skills broke down (<u>A Perceptual Survey Rating Scale</u>, Kephart, 1960). This test battery was recently expanded to include "Rhythmic Writing" in which patterns of letters and shapes were to be reproduced using continuous movements (Kephart, 1965). The visual-motor tests examined the laterality, directionality, and eye-hand co-ordination of the child, and his ability to maintain a constant rhythm in movements and to adjust appropriately to new positions. In "Rhythmic Writing", motifs (designs or patterns of letters) were copied by the child and were evaluated according to the following criteria: (1) <u>rhythm</u>, a "smooth certain and

consistent performance", (2) reproduction, letters approximately the same size and form, and (3) orientation, motifs in adequate direction and position. No information was available concerning the use of the rhythmic writing test in research.

Pattern copying had been used in reading readiness tests and research studies investigating visual perception and reading (Goins, 1958; Glennon, 1961). Printing ability was examined by Clyde (1955) who found no correlation between printing and reading achievement at the end of grade one. However, most of these studies were assessing the ability of the child to deal with isolated forms rather than linked patterns which had to be reproduced in a continuous or rhythmic movements.

RHYTHMIC ABILITY IN READING

The relationship of rhythmic ability to reading has been of some interest to educators. Drake stated that children with reading, spelling, and writing disabilities had been observed by speech and music specialists to have an"arhythmic" quality to their speech and to be deficient, when compared to normal readers, in their "sense of rhythm" as indicated by clapping and dance movements (1964, p. 203).

One implication of these comments was that poor

readers seemed to be less sensitive to intonation patterns and sentence patterns--cues which help the normal reader learn and anticipate language structure.

Vernon (1957) considered that problems in sound blending might be related to difficulty with temporal order and rhythm. She described a study by Stambak which indicated that poor readers between seven and fourteen years of age were much poorer than average readers in copying rhythmic tapped patterns, that they did not improve with increasing age as did normal readers, and that they were less able in tapping the rhythm of a familiar song. Vernon stated:

> This reproduction of rhythm appeared to have a certain relationship to the association of spatial and temporal order which occurs in reading (that is to say, order of printed letters and succession of letter sounds). This perception of correct order is vitally important in word recognition, writing and spelling; and inability to perceive in this way may be one of the factors making for difficulty in reading (1957, pp. 19-20).

De Hirsch suggested that dyslexic children had difficulty in patterning in various areas--motor, visuo-motor, and perceptual configurations--and that this extended to temporal organizations. She remarked:

> It is of interest that a number of workers, like Stambak and Mottier have consistently found rhythmic difficulties in children suffering from reading disabilities, especially those whose oral language is already somewhat insecure (1957, p. 570).

De Hirsch included tapped-out patterns in a battery of

tests used to identify potential reading problems and had found that a number of children could not repeat even a short series of taps.

Godfrey (1964c) referred to a study by Carton who found that children of low reading ability scored significantly lower than children of high reading ability in an auditory-motor rhythm test. The test demanded that the child repeat a series of tapped patterns which were presented by the examiner. Because of the high reliability between the pattern tapped using the dominant hand and that tapped with both hands, the investigator concluded that hand dominance did not appear to be a factor in auditory-motor rhythm.

Using A Perceptual Survey Rating Scale to measure perceptual-motor ability, Swanson, in another study discussed by Godfrey, found a significant positive relationship between this ability and reading and number readiness in kindergarten children. Concerning this research Godfrey says:

> The correlation was slightly lower for the Perceptual-Motor Survey than for the Metropolitan Readiness Test, leading the investigator to observe that the hypothesis that the PMS was a predicator of success in the first grade was tenable but that as Kephart had stated, it was probably best used as an additional determiner of prediction with other applicable measures (1964c, p. 5).

Birch and Belmont (1964 and 1965) used a task in which children had to equate visual and auditory patterns

to test the thesis, advanced by Birch, that a primary inadequacy in the ability of the child to integrate auditory and visual stimuli might be one of the causes of reading disability. Comparisons were made between the performances of retarded readers and normal readers between the ages of 9.4 and 10.4 on a test of auditory-visual integration. In addition, a developmental study was made of auditory-visual integration in children between five and twelve years and the relationship of this integration to intelligence and reading was examined. In the first study (1964), 50 normal readers and a total population sample of 150 retarded readers were compared in their ability to match a tapped pattern with a visual pattern of dots. The difference between the two groups was significant; the poor readers were less able to judge the equivalence of the auditory and visual patterns. There was an overlapping between the groups but the investigators concluded that "for certain individuals" a defect in auditory-visual integration could be a contributory factor to poor reading (1964, p. 860).

In the second study, Birch and Belmont found that in their sample of bright normal middle-class children, the greatest gains were made in auditory-visual integration between kindergarten and grade two. Birch stated:

> It is of interest that the rapid period of integrative growth in auditory-visual functioning

> coincided with those ages in which Birch and Lefford (1963) have demonstrated the most rapid emergence of visual-haptic, visual-kinesthetic, and haptic-kinesthetic integrative competence (1965, p. 303).

The inference taken from Birch's research was that normal children in this age range--a period which coincides with early reading instruction--could be expected to show considerable development in the ability to integrate information from all sense modalities.

RHYTHMIC ABILITY IN MOTOR DEVELOPMENT

The bulk of the research on rhythm emphasized the importance of the motor component both in the perception of rhythm and in the overt response itself. However, efforts to measure rhythmic motor responses were not particularly successful. Although rhythm tests had been included in tests and measurements in physical education over a period of years, Clarke (1945) informed educators that efforts to measure motor rhythms had not yet reached the practical stage. The situation had not changed over the next decade according to Landreth (1958). Complicated devices had been used experimentally to measure the responses of older children and of adults, but these precise measurements seemed to have little practical value for educators.

Developmental scales of children's motor development referred to rhythm in a general way. Gesell (1946)

stated that two year olds responded to rhythm by bouncing, tapping, and swaying; four year olds could demonstrate their individual interpretations to rhythm; eight year olds moved more rhythmically and gracefully than previous ages. However these observations were not specific enough to serve as measures of this ability.

One of the problems in developing measurements of motor ability was expressed by Anderson (1939) who said that there was no single universal motor skill that developed after locomotion. Later development apparently depended on the opportunities which were presented in the physical and cultural environment. Kephart suggested that opportunities for children to engage in the random and wide experimentation necessary to build up a broad base of elementary skills were becoming increasingly limited in our modern world (1960, p. 15).

Problems existed, apparently, not only in selecting suitable tests of motor ability but also in identifying capable examiners. Sloan remarked that the motor skill of the examiner might be a variable in the test situation (cited by Cron, 1957). Godfrey (1946c) observed that inadequate tests and the particular bias or training of the examiner might cause the low correlations, found in some studies, between tests of motor skills and intelligence.

Godfrey intimated that there was a new trend emerging in evaluating procedures used in physical education, particularly in the education of slow learners and other handicapped children. The Motor Therapy Laboratory at Perdue University, where Godfrey had worked with Kephart, made an important distinction between motor skills and motor patterns. Godfrey (1964) and Kephart (1964) stated that motor skills demanded training and repetition of specific, accurate movements which might be limited in scope; motor patterns, on the other hand, involved groups or series of movements which were used to explore and experiment, which could be applied to many situations, and which developed through experience in many varied situations. Evaluation of motor patterns is undergoing investigation at the Motor Therapy Laboratory in an attempt to develop more adequate tests and to re-orient examiners to these new developments.

The relationship of rhythm to movement, position, and posture has already been suggested (Freeman, in Herrick, 1963). Work by Gesell, Kephart, and others emphasized the effect of posture on all movement. Gesell considered posture to be "the key concept for the adequate interpretation of the child's development" although he believed that this concept must be expanded to include fine muscle co-ordination (1946, p. 230). Concerning

posture, Kephart said, in part, "Learned movement patterns and learned responses can only result from the elaboration and re-organization of the basic posturing mechanisms" (1960, p. 40).

The importance that Kephart placed on posture, balance and movement, and their relationship to perceptual-motor development was apparent in his test _A Perceptual Survey Rating Scale_. The visual-motor tasks, which included the test on rhythmic writing, have already been discussed. Other tasks, also designed to assist teachers and specialists to evaluate the child's perceptual-motor readiness for learning, included: (1) tests of ability to maintain balance in walking a board, and jumping tasks, (2) tests of ability to vary movements by skipping and by hopping in rhythmic patterns, (3) tests of ability to imitate movements, and (4) tests of ability to instigate movements according to verbal directions. In addition, laterality, directionality, body image, orientation, eye-hand co-ordination, and form perception were examined in this scale. According to Kephart, if the child's skills broke down at any point, he would need training in the basic motor patterns underlying the activity, otherwise only isolated or "splinter" skills of limited use could develop. The Kephart Scale had been used in research at Purdue University but detailed information about these

studies was not available.

McCaskill and Wellman (1938) supplied some normative data concerning motor tasks which resembled items in the Kephart Scale (for which no precise norms have been provided). In a study of motor achievement in pre-school children, girls were found to be somewhat superior in hopping and skipping tasks and boys showed more skill on steps and ladders. In the combined group of boys and girls, the ability to hop on both feet (1-3 steps) appeared at 38 months, and hopping on one foot (1-3 steps) at 43 months. Skipping, using alternate feet, was achieved at 60 months. Correlations between skills were high and there was a wide spread in ability at each age level. As the Kephart Scale was designed primarily for children between six and nine years of age, it was apparent, from McCaskill's findings, that such skills as simple hopping, jumping, and skipping were usually acquired before the children entered school. If this development had not taken place, it was conceivable that retardation in motor ability might undermine school progress.

Godfrey (1964c) discussed a study by Ismail, Kephart, and Cowell, in which the effectiveness of parts of the Kephart Scale and other motor tests in predicting school achievement was assessed. Results indicated that intelligence test scores could be predicted more

successfully for low achievers than average or high achievers. The investigators suggested that, when using tests of motor ability, measures of balance and co-ordination contributed most to predictions of academic success.

Experimental and observational data concerning balance and co-ordination in young children was available from other sources. Silver (1952) stated that children with reading disability showed, in general, less organized and immature postural reflexes than would be expected from their age and intelligence. Silver proposed that this might be part of a syndrome of reading disability which included primitive visual-motor Gestalten, poor left-right orientation, and difficulties in figure ground perception.

Data was supplied by Cron and Pronko (1957) who, using a walking board, examined the development of a sense of balance in children between the ages of four and fifteen years. Between the ages of four and eight years girls were found to be better than boys in balancing; boys showed superiority after this age. Cron cited Jenkins who found that girls of five, six, and seven years surpassed boys in the ability to hop on one foot (a test of balance). However, there were great individual differences in performance and attitude at all age levels in both studies. In Cron's investigation, it was observed that some children approached the task with great caution and others with

complete confidence.

This factor of attitude has been noted in other studies. Jersild (1939), referring to a study by Wellman, commented that, whereas mastery of skills did not seem to have specific carry over to mental ability, the effect of mastery or competence on social and emotional development might be significant. Wight (1937) also noted that the increased confidence resulting from training in making rhythmic responses to music had implications for the education of handicapped children, and awkward and clumsy children in general.

There have been several studies which compared the motor abilities of retarded children and normal children, but few which examined rhythm in particular. Sloan (1951) using the <u>Lincoln Adaptation of the Oseretsky Test of Motor Proficiency</u> to compare retarded and average children, found a statistically reliable difference between the two groups on all sub-tests. He concluded that motor proficiency was related to intelligence, that it was part of the total functioning of the organism, and that more complex motor behavior required integrative behavior which might be an aspect of intelligence. Francis and Rarick (1959) compared the motor characteristics of the mentally retarded with published norms for tasks which included running speed, power or dynamic

strength, balance, and agility, and found that the means of retarded boys and girls were from two to four years below those of normal boys and girls.

CONCLUSIONS

On the basis of the review of the research, a further investigation of rhythmic ability seemed warranted for the following reasons:

1. To determine whether rhythmic ability was related to reading achievement - thus deserving more consideration in reading readiness programs.
2. To determine whether there were rhythmic ability tests which had more significance for reading achievement than did others - thus justifying further investigation in these areas.
3. To examine the possibility that the ability to recognize and respond to patterns was a generalized rather than a specific ability - thus directing attention to more varied techniques for diagnosis and training.

Accordingly, tests were selected by the present investigator which examined the ability of the child to respond to auditory, visual, and motor patterns. When possible, the response to the pattern was to be made using a different sensory avenue than that in which the

pattern was presented, in order to assess the ability of the child to "recode" and "order" the information. A measure of balance and general co-ordination was included for the purpose of relating elementary or basic motor skills to the more specific motor responses demanded in other tests. An attempt was made to select tests which could be utilized by primary and reading specialists, if they were found to bear a significant relationship to reading achievement.

SUMMARY OF RESEARCH

Research findings related to the development of rhythmic ability in young children, methods of measuring this ability, and its implications for learning were reviewed in this chapter. Emphasis was given to the work of investigators who believed that the over-all efficiency of a child's behavior was strongly influenced by the degree to which he could integrate the information he received through his various senses. Particular attention was paid to studies which had developed methods of examining a child's ability to pattern his responses--as evidenced by motor responses--according to different types of non-symbolic stimuli.

Findings from research in music indicated that improvement in ability to make rhythmic responses was

more apparent in the pre-school years, but that some gain was made after that time with increasing age and experience. Although there was conflicting opinion over the amount of improvement possible through training and the form the training should take, there was general agreement that opportunities for making rhythmic responses should not be left to incidental or occasional experiences. These conclusions had implications for nursery school, kindergarten and elementary school programs. Standardized tests of rhythmic musical ability either did not have practical value for testing young children, or were not suitable for the purpose of this study.

Although research findings did not give evidence of the presence of rhythm in handwriting, attention was directed to the examination of the ability of the child to write letters as wholes or units, controlling and patterning his movements smoothly and efficiently. Difficulties in making these observations were noted. Authorities recognized that the performance of the child had to be studied in the light of his level of maturation and knowledge of his previous experience. Despite the problems involved, it appeared that the ability of the child to control his movements in writing patterns might be fruitfully examined. According to one writer, this "control" might result from the development of a "splinter

skill"; however, by demanding that the child write at the blackboard using fairly large patterns, he was in a situation where a narrow skill (control of finger movements) broke down and the examiner could relate the writing to the more general area of motor control and co-ordination. Tests of perceptual-motor ability which permitted these observations to be made were described.

In reading, the suggestion was made that initial success in this subject might be related to the level of intersensory integration of the child, and that methods for determining this level might include examination of the ability to respond to patterns in stimuli. Tests of tapped out patterns and auditory visual integration which dealt with the ability of the child to respond to auditory stimuli were discussed in relation to reading. As the majority of research available on perception and reading had been concerned with visual and visual-motor ability, the studies by Birch and Belmont (1964 and 1965) and Stambak (as cited in Vernon, 1957) which examined auditory perception of sound patterns, were of particular interest. The proposal that the ability to equate different sensory patterns had more significance at the beginning stages of reading instruction had implications for reading readiness programs but seemed in need of further investigation.

The theory that motor patterns should be examined,

rather than motor skills, was put forward by Kephart (1964) and Godfrey (1964a)--the implications from research and investigation being that the ability to pattern more complex movements depended on the adaptability of basic motor patterns. Measures of posture, balance, and co-ordination were suggested as useful predictors of general motor abilities and intelligence at the lower levels. There was some evidence that children of poor ability might be limited in their learning through inadequate development in these areas. The findings suggested that these children were handicapped because the information they received from their senses was so unreliable and inconsistent that it could not be efficiently integrated. Because much of the early learning of the child depended on sensory-motor interaction with the environment, an examination of basic motor patterns may provide some insight as to the nature of the learning problems and to possible remedial procedures.

Findings from different areas of research suggested that rhythmic ability contributed to the efficiency of a child's performance by permitting him to anticipate probable combinations of stimuli and/or to make ready adjustments to new patterns.

On the basis of a review of the related literature, tests were selected which were considered to be adequate measures of rhythmic ability in young children.

CHAPTER III

THE EXPERIMENTAL DESIGN

This chapter will describe the nature of the testing population and the selection of the sample, the testing instruments, the pilot study, the testing procedures, and the statistical treatment of the data.

THE SAMPLE

The sample was drawn from the children in grade one and grade three in three elementary schools which had been assigned to the investigator by the Edmonton Public School Board. All the schools had been built during the past ten years and had been in operation for at least seven years. Approximately one-third of the children came from an area of high cost housing, one-third came from an area of one family dwellings of average cost, and the remaining third came from an area of average and low cost housing. There were between 85 and 110 children in each grade in each of the schools, with the larger enrolment in grade one.

Children who were completing their first or third year of schooling, who were rated as being either good or weak readers, were eligible for inclusion in the sample. The number of years in school was verified by checking the school records. Initially, reading ability was assessed

by the classroom teachers who selected children from the top and bottom thirds of their classes in reading achievement.

Because there were conflicting opinions as to whether mixed or crossed dominance affects the perception of spatial organization and might thus mask rhythmic ability in the visual-motor tasks, it was decided to limit the sample to right-handed, right-eyed children. The preferred use of the right hand for writing or printing was accepted as temporary proof of handedness. This was supplemented by observations of the hand used for tapping and drawing tasks as the testing progressed. The screening for eye dominance, by the investigator, eliminated from the sample the children who were left-eyed or who performed inconsistently. This necessitated the inclusion of children who were considered to be low average or high average in reading ability in order to obtain a large enough sample.

Information concerning the eye dominance of the total group included in the preliminary screening is presented in Table I. Children who used their right eye for at least eight of the nine tests for eye dominance were judged to be right-eyed and were selected for the sample. Children who, by their inconsistent performance, gave evidence of lack of eye dominance were given the

complete battery of tests but were excluded from the sample. Testing was not completed with those children who used their left eye for the first five items; they were assumed to be left-eyed.

TABLE I

EYE DOMINANCE OF RIGHT-HANDED CHILDREN IN HIGH AND LOW READING ABILITY GROUPS BEFORE SELECTION OF SAMPLE

Level and Grade	Number Tested	Right-eyed		Left-eyed		Inconsistent	
		No.	%	No.	%	No.	%
High 1	72	42	58.3	21	28.6	9	12.5
Low 1	65	32	49.2	21	32.3	12	18.4
High 3	54	35	64.8	12	22	7	12.7
Low 3	70	34	48.5	28	40	8	11
Total	261	143	54.8	82	31.4	36	13.8

Of the 261 right-handed children screened for eye-dominance, 143 were right-eyed, 82 were left-eyed, and 36 were inconsistent in their eye preference, according to the criteria outlined for this study. In the sample of grade one children, approximately 58 percent of the good readers were right-eyed compared with 49 percent of the poor readers. Of the remaining children in the grade one sample, there were more poor readers than good readers who were

inconsistent in their preference (approximately 18 percent of poor readers to 13 percent of good readers) or who were left-eyed (approximately 32 percent of poor readers to 29 percent of good readers). Differences were more pronounced in a comparison of the grade three groups (approximately 65 percent of good readers and 49 percent of poor readers being right-eyed and 22 percent of good readers and 40 percent of poor readers being left-eyed) except in the "inconsistent" category in which the performances were fairly similar. No firm conclusions could be drawn from this comparison, although the drop from 18 percent to 11 percent in the inconsistent performances from grade one to grade three suggested that eye preference became more stable over time.

Following the screening for lateral dominance, and the exclusion of children who had known physical disabilities or emotional problems, 124 children were selected to receive the tests of rhythmic ability.

Group intelligence tests, administered to all children during their first month in grade one, were used as a measure of intelligence. The sample was reduced in size when only the children who had received either the Lorge-Thorndike Intelligence Test (Level 1, Form A) or the Detroit Beginning First-Grade Intelligence Test were included in the study. One school had been recently

incorporated into the city system and the children from this school had received the Lorge-Thorndike Intelligence Test. All the grade three children from the two remaining schools, who were included in the sample, had received the Detroit Beginning First-Grade Intelligence Test (Revised). All the grade one children from these two schools, who were included in the sample, had a Deviation I.Q. derived from their test scores on the Detroit Beginning First-Grade Intelligence Test (Revised) according to a scale adopted by the Edmonton Public School Board (based on a study carried out at the University of Alberta in the Department of Educational Psychology). The scores of the Lorge-Thorndike and Detroit Intelligence Tests were equated with the Deviation I.Q.s by using the means and standard deviations from studies of these tests on local populations (Flahtman, 1963; Fornwald and Knowles, 1965). Table II presents a summary of information concerning chronological ages, mental ages, and intelligence quotients of the four reading ability groups.

TABLE II

SUMMARY OF CHRONOLOGICAL AGES, MENTAL AGES, AND INTELLIGENCE QUOTIENTS, BY GROUPS

	Chronological Age (months)	Mental Age(months)	Intelligence Quotient
Grade 1 High			
Mean	83.80	92.28	110.32
Standard Deviation	3.53	5.79	7.37
Grade 1 Low			
Mean	83.24	81.12	97.92
Standard Deviation	3.04	6.74	8.59
Grade 3 High			
Mean	106.56	115.64	108.52
Standard Deviation	3.41	8.22	7.17
Grade 3 Low			
Mean	106.68	112.36	105.44
Standard Deviation	3.72	9.83	8.74

The letter grade standings in arithmetic, physical education, and printing or writing, which indicated the level of achievement of the children in the spring term, 1965, were obtained from the school records. These standings were arbitrarily converted to raw scores by selecting the approximate mean of the range of marks represented by each letter, the range of marks having been set by the Edmonton Public School System. The following table was used:

H + : 95	A + : 76	B + : 61	C + : 47
H : 90	A : 72	B : 57	C : 44
H - : 85	A - : 68	B - : 53	C - : 42
			D : 30

The raw scores for each child in each of the city-wide reading tests administered by the classroom teachers in June 1965 were recorded. These marks were used to confirm the placement of the child in one of the reading ability groups for his grade. The reading tests administered were as follows:

Grade One

1. Word Recognition, E.P.S.B., 1964, set by the Edmonton Public School Board.

2. Gates Primary Paragraph Reading, Form 2.

Grade Three

1. Word Meaning, E.P.S.B., set by the Edmonton Public School Board.

2. Gates Paragraph Reading: Reading for General Significance, Type GS, Form 1.

3. Gates Paragraph Reading: Reading to Note Details, Type ND, Form 1.

The original sample was further reduced in size when children were excluded who had not received the complete battery of reading tests for their grade. The final sample, as indicated in Table III, consisted of 100 children--50 girls and 50 boys.

TABLE III

COMPOSITION OF READING ABILITY GROUPS ACCORDING TO SEX

	Grade 1		Grade 3	
	High	Low	High	Low
Girls	13	12	15	10
Boys	12	13	10	15
Total	25	25	25	25

TESTING INSTRUMENTS

The tests which will be described in this section are (1) screening tests for eye dominance, and (2) rhythm tests. Both series of tests had been selected by the investigator on the basis of a review of the literature on the subject. The tests for eye dominance were in current use in research and diagnosis. The rhythm tests appeared to be potentially useful tools with which to assess a child's rhythmic ability (the ability to reproduce or match rhythmic patterns in response to different kinds of stimuli). Each test will be discussed in terms of its purpose, source (including validation) and description. The precise methods for administering, evaluating and scoring are included in the appendices.

Tests of Eye Dominance

These tests were used to identify the right-eyed children in the sample of right-handed children. Selection of the tests had been made from the professional literature on eye dominance and included the following: (1) sighting through a tube (Harris, 1956), (2) sighting through a small hole in a cardboard screen (Harris, 1956), (3) sighting a coin through a tube (Kottmeyer, 1959), (4) three trials of sighting using a cardboard screen at arm's length (Harris, 1956), and (5) three trials of sighting using a V-shaped cone (Bond and Tinker, 1957). A review of studies by Birch and Belmont (1963), Hellerich (1964), and Balow (1964) indicated that the screening tests which were selected were similar to those currently being used in research on lateral dominance.

In these tests the child, using one eye or both eyes, was asked to sight objects using devices which permitted the examiner to note the preferred or dominant eye. On the completion of each task, the eye used for sighting was recorded. Children who used the right eye for at least eight of the nine tasks were assumed to be right-eyed. Appendix A describes the method of administration, evaluation, and scoring of the tests.

Tests of Rhythmic Ability

The tests of rhythmic ability included the

following:

1. A series of eight tasks (included in the test <u>Jumping</u>) which permitted examination of the child's ability to perform integrated movements involving both sides of the body.
2. One test of auditory-motor ability, in which the child tapped a series of patterns in response to auditory cues only.
3. Four tests of visual-motor ability, two of which examined the child's ability to draw simple forms from memory, and two tests which provided him with more complex patterns which were to be copied.
4. One test of memory for movement (<u>Knox Cube Imitation Test</u>) in which the child could utilize visual, auditory, and motor cues as he observed and duplicated a series of regular and irregular patterns tapped on a set of four blocks.
5. One test of auditory-visual integration, in which the child matched a pattern of tapped sounds (which he observed being tapped) with a visual pattern of dots.
6. One test of ability to perform integrated movements in response to auditory, visual, and motor cues (<u>Clapping</u>).

The tests were administered in the order in which they have been listed.

Jumping. This test was designed to give information about a child's laterality, body image, and rhythm, through observations of his balance and posture as he performed against the pull of gravity. The test was used in this study as a measure of balance, gross muscle co-ordination, and of ability to establish and maintain rhythmic motor patterns. There was no attempt to evaluate laterality or body image although the general efficiency of the motor patterns might reflect development in these related areas. This test was taken from A Perceptual Survey Rating Scale which was developed by Kephart (1960) to aid teachers and other specialists in evaluating the perceptual-motor development of children between the ages of six and nine years. The Scale had been used in clinical investigations of children with learning problems, predominately at the Achievement Center, Purdue University, and is presently being used as a basic motor diagnostic instrument and as an aid in assessing progress in programs of motor therapy (Godfrey, 1964a). The use of a test of balance and posture to assess basic movement patterns was supported by Gesell (1946), Silver (1952) and others.

In this test the child was asked to perform eight tasks of increasing difficulty. The tasks included: (1) bilateral activity, in which both sides of his body were used symmetrically, as in jumping, (2) unilateral

activity, in which one side of the body was used, as in hopping, and (3) alternating activity, in which regular and irregular patterns of movement were demanded. The regular alternation activity included skipping and hopping; the irregular alternations involved more complicated hopping patterns. The factor of control was present in all of the tests whereas rhythm was emphasized in the hopping tasks. Standardized norms for this test were not available but developmental scales from other sources (McCaskill, 1938, and others) indicated that the bilateral and unilateral activities, and one alternating activity (skipping) were performed by 60 percent of children at the age of five years. Kephart (1960) stated that failure of any of the first five items--jumping, skipping, and simple hopping--suggested that the child should receive training in gross body control; failure on only the last three items--the more complex hopping tasks--pointed to the need for rhythm training. Appendix B describes the administration, evaluation, and scoring procedures.

Auditory-Motor Match. The purpose of this test was to determine the child's ability to recall and reproduce a pattern of sounds by using tapping movements. The tapping patterns were obtained from the Learning Clinic, Montreal Children's Hospital and were based on tests of rhythm devised by Stambak (1960). Because it

seemed possible that viewing the test patterns being tapped would give the child auditory, motor, and possibly visual cues, it was decided to restrict the cues to the sound of taps only. The method of administration was determined, therefore, with this in mind. The timing and directions were based on the test Auditory-Visual Integration which is described later in this section. Stambak, Mottier, and De Hirsch (1957) have been cited as using tests of tapped-out patterns to identify poor readers. Similar tests have been used to assess cross-modal "coding" by O'Connor and Hermelin (1963) in their work with severely retarded children.

The child was asked to tap a series of twenty-one patterns, ranging from simple to complex,which was presented by the examiner. During the presentation of the test items the examiner's hand was hidden from the view of the child by a screen. Appendix C describes the method of administration, evaluation, and scoring of this test.

Circle Drawing. This test was used in the study in order to examine the ability of the child to translate his memory for a simple form into a rhythmic motor pattern. The evaluation was in terms of how the movements were performed as well as the product of the activity. The test was part of A Perceptual Survey

Rating Scale, and is described in detail in The Slow Learner in the Classroom (Kephart, 1960). According to Gesell (1946) and Terman (1937) children with a mental age of three years should be able to draw a circle.

The test was conducted with the child standing at a chalkboard easel four feet by five feet in size. He was asked to draw a circle; no other instructions were given for the first circle. The circle was evaluated according to: (1) size, (2) direction of movement, (3) position in relation to the child's body, and (4) shape. If the child drew a very small circle he was asked to make larger ones until a satisfactory full arm movement was used. Administration, evaluation, and scoring procedures are given in Appendix D.

Double Circle Test. This test was designed to give information about the child's laterality, directionality, the degree of correlation between movements of the two sides of the body, and the extent to which the child relied on visual and/or motor cues while performing the task. In this study the test was adapted and used for the purpose of comparison with the other tests of bilateral activity, Jumping and Clapping. Laterality was not evaluated. The test was taken from A Perceptual Survey Rating Scale, Kephart (1960).

In this test the child was asked to take a piece of

chalk in each hand and to draw two circles simultaneously on the chalkboard. If the drawings were very small he was requested to make them larger. The circles were evaluated according to: (1) relative size, (2) position of drawings with reference to each other, (3) direction of movement of the two hands, (4) relative accuracy, and (5) attention. Administration, evaluation, and scoring procedures are given in Appendix D.

Rhythmic Writing. The purpose for administering this test was to get information about the child's ability to translate a visual pattern into a rhythmic motor pattern. The writing motifs and evaluation criteria for this test were received from Dr. N. C. Kephart, Purdue University, March 1965. The test constituted an addition to *A Perceptual Survey Rating Scale*, Kephart (1960). Although "rhythm" had not been identified as a factor in the writing movement according to Herrick (1963), the present investigator assumed that rhythmic ability was indicated if the child could reproduce a visual pattern by using smoothly co-ordinated movements. Visual perception was involved as the child had to recognize that the pattern consisted of identical units, but credit was given for rhythm only if the child could pattern his movements smoothly and accurately. In Freeman's terms each unit of the pattern would be reproduced "in a

succession of movements, all of which tend to be made in equal intervals of time" (1939, p. 256). He clarified this further by saying that a letter would be written as a whole rather than as a succession of separate strokes. This interpretation of Freeman's was discussed in Chapter II of this study, and was used to supplement the evaluation criteria given in Appendix D.

In this test the child was asked to duplicate the first six of a series of eight "writing" patterns of increasing difficulty, which were presented to him individually. The "writing" pattern was presented as a whole on the chalkboard, and the child had to reproduce it using an ordered sequence of movements if his performance was to be satisfactory. The method of administering this test was not available from the test outline; it was devised, therefore, by the present investigator. Administration, evaluation, and scoring procedures are given in Appendix D.

Rhythmic Designs. This test was given to determine the ability of the child to translate simple visual patterns into movement patterns, building up a progressively more complicated design. The test was devised by the present investigator. It seemed possible that some of the younger children would have difficulty with the more complex writing patterns in the preceding tests, despite

the elimination of two of the more difficult motifs. This test was included to provide material at an easier level to supplement the motifs in the Kephart Scale.

The child was asked to reproduce four simple patterns which were presented separately. The patterns were built up progressively into a design on the chalkboard. The designs, directions for administration, evaluation, and scoring are given in Appendix D.

Knox Cube Imitation Test. This test was used to determine the ability of the child to recall and duplicate a series of movements (motor patterns). As no other form of this test was available the patterns were taken from Cattell (1936) and the directions from Kuhlman (1922). The sequence of presentation was based on Pintner's modification as outlined by Cattell. According to Goodenough (1949) the Knox Cube Test had also been incorporated into standardized "performance" tests such as the Arthur Point Scale and the Minnesota Preschool Scale.

In this test four one-inch cubes were placed in a row at distances of one inch. Using a fifth block the examiner tapped a series of patterns (regular and irregular). After tapping a pattern, the examiner placed the block in front of the child and told him to tap the same pattern. Kuhlman considered that the successful use of the test demanded the child's close attention

for each trial. Administration, evaluation, and scoring procedures are given in Appendix E.

Auditory-Visual Integration. This test was used to determine the ability of the child to match a set of auditory-stimuli (tapped patterns) with a set of visual stimuli (dot patterns). The directions for administering the test, the auditory and visual patterns, and the method of scoring were taken from a study by Birch and Belmont. The test was designed to measure auditory-visual integration; it was developed to examine a hypothesis of Birch's

> ...that a primary inadequacy in the ability of the child to integrate auditory and visual stimuli may be one of the causes for reading disability (1964, p. 853).

In this test a pattern was tapped by the examiner and the child was asked to select a matching visual dot pattern from a multiple choice item. Administration, evaluation, and scoring procedures are given in Appendix E.

Clapping. In this test an attempt was made to estimate the ability of the child to reproduce handclapping rhythms. Although such measures might be unreliable (Heinlein, cited in Lundin, 1953) this informal test was included to see if "teacher-judgment" of ability to keep time bore a relationship to other measures of rhythmic

ability which were included in this battery of tests. The patterns and nursery rhyme were selected by the present investigator.

In this test the examiner clapped a series of four short patterns in which identical units were repeated. On the completion of each item the child was asked to clap the same pattern. In the fifth item of the test the examiner and child, in unison, repeated a simple nursery rhyme to which the child alone clapped in time. Further details of this test are given in Appendix E.

THE PILOT STUDY

A pilot study was conducted during May 1965 in one of the three elementary schools which had been made available to the investigator by the Edmonton Public School Board. The purpose of the pilot study was to examine further the suitability of the tests which had been selected to measure rhythmic ability, and to clarify the methods of administration, evaluation, and scoring.

Because the testing was to be conducted at two grade levels (grades one and three) the sample included ten children from each of these grades. These children were not screened for eye dominance and were not included in the final sample.

An independent examiner was present for one half

day of testing when children from each grade level were tested. In a joint consultation, the observer and the investigator decided that several changes were necessary. Slight alterations were made in the testing instructions with the insertion of minor additional directions and the setting of a fixed number of trials for each sample or practice task. This latter change was made to ensure uniformity of opportunity and presentation. Some major changes were made in scoring the visual-motor tests. Because of the possibility that there would be subtle alterations in the qualitative judgments as the study progressed, this type of evaluation was reduced to a minimum. Rather than judge a performance as a whole, points were assigned to specific aspects of a performance; these points were totalled, resulting in a quantitative score. By making this modification the original purpose of the test designer may have been distorted or lost. However, as the tests were to be used to compare the performances of children at different ages and ability levels rather than to assess the broad comprehensive performance patterns of individuals, these changes were considered to be appropriate. The order in which the rhythm tests were to be given was decided after taking into consideration factors of attention span, interest and fatigue. Appendices B, C, D, and E,

give details of the tests in the order of their presentation to the children.

The results of the pilot study suggested that the tests selected were related to the problem, that they took from twenty-five to forty minutes to administer, and that they were of interest to the children.

TESTING PROCEDURES

The group intelligence tests and group reading tests were administered and marked by the classroom teachers. The screening tests for eye dominance and the tests of rhythmic ability were administered individually to each child during May and June 1965, by the investigator. Rhythmic ability tests were scored by the investigator.

TREATMENT OF DATA

The data obtained from the testing program was examined: (1) to determine whether there were changes in rhythmic ability from grade one to grade three, (2) to determine whether there were differences in rhythmic ability in children of different reading ability within each grade, (3) to determine whether there were changes in rhythmic ability in reading ability groups from the grade one level to the grade three level, (4) to determine whether there were sex differences in rhythmic

ability, and (5) to investigate the relationship of rhythmic ability to reading achievement in each grade and reading ability group.

In order to do this the following statistical treatment was carried out by the Computing Centre, University of Alberta, Edmonton:

1. The means and standard deviations were computed.
2. The conventional t-test was applied to the means for grades, reading ability groups, and groups according to sex.
3. Intercorrelations of all test scores were obtained for each grade and reading ability group. The significance of the correlation coefficients was obtained from Ferguson (1959) Table F.

CHAPTER IV

ANALYSIS OF DATA AND INTERPRETATION

This chapter will examine the data obtained from the testing program carried out with grade one and grade three children, at two levels of reading ability within each grade, who were in attendance at three elementary schools in Edmonton, Alberta, in May and June 1965. The purpose of the analysis will be: (1) to determine whether there are changes in rhythmic ability between grade one and grade three, (2) to investigate the relationship between rhythmic ability and reading achievement in grade one and grade three, (3) to determine whether there are differences in rhythmic ability between good and poor readers in grade one and grade three, and (4) to determine whether there are differences in rhythmic ability between boys and girls at these grade levels.

The results of the statistical treatment will be analysed in the following order:

1. Comparison of Performances in School Achievement and Rhythmic Ability Tests by Total Grades
2. Relationship between Rhythmic Ability and School Achievement in Total Grades
3. Comparison of Relationships between Rhythmic Ability and School Achievement

4. Comparison of Rhythmic Ability in High and Low Reading Groups Within the Grades
5. Comparison of Rhythmic Ability in Reading Ability Groups Between the Grades
6. Sex Differences in Rhythmic Ability
7. Summary of Findings

COMPARISON OF PERFORMANCES IN SCHOOL ACHIEVEMENT AND RHYTHMIC ABILITY TESTS BY TOTAL GRADES

In order to assess the performances of the grade one and grade three children in areas of achievement in addition to reading, the means for tests in intelligence and in selected school subjects (printing or writing, physical education, and arithmetic) were obtained. Examination of the similarities and differences in these general areas, based on a comparison of the means for all tests for the separate grades, preceded a more detailed analysis of the performances in the rhythmic ability and reading tests.

General Abilities

The selection of children for the study was on the basis of grade, reading achievement, and lateral dominance. The assumption that a wide range of reading ability would be present in each grade was confirmed by an examination of the significant differences, at the one percent level

of confidence, which were found between the means for the high and low reading groups for all reading tests administered to each grade in June 1965, by the Edmonton Public School System (Table IV). However, the screening for right eye and hand dominance had reduced the numbers of children in the original selection (Table I, page 40) and made it necessary to include children in each grade sample whose reading achievement was rated as "average" rather than "high" or "low". Therefore, it was apparent that the differences between the means in reading tests, and possibly in other areas of achievement, would tend to underestimate the spread in ability which would exist between groups of children selected on the basis of reading ability alone.

Table V, page 64, presents the means and standard deviations for each grade for scores obtained on intelligence tests, on the total rhythm test battery, and in the school graded subjects--printing or writing, physical education, and arithmetic. There was no significant difference between the means for intelligence for the two grades (Grade 1 Mean 104.12; Grade 3 Mean 106.98). The similarity in the means for printing or writing (Grade 1 Mean 63.30; Grade 3 Mean 59.44), physical education (Grade 1 Mean 62.56; Grade 3 Mean 64.50), and arithmetic (Grade 1 Mean 65.08; Grade 3 Mean 64.26) indicated that,

TABLE IV

MEAN SCORES FOR READING ACHIEVEMENT TESTS
FOR HIGH AND LOW READING ABILITY GROUPS
IN GRADE ONE AND GRADE THREE

Number of pupils--50		High Group--25		Low Group--25		
		High Group		Low Group		
Reading Tests	Possible Score	Mean	S.D.	Mean	S.D.	"t"
	A	B	C	D	E	F
Grade One						
E.P.S.B. Word Test I	100	87.20	8.31	49.72	13.38	11.66**
Gates PPR Test	26	22.76	1.84	16.60	3.76	7.20**
Grade Three						
E.P.S.B. Word Test III	53	38.28	5.06	24.24	4.55	10.12**
Gates ND Test	51	30.20	5.40	18.04	5.75	7.55**
Gates GS Test	26	13.84	3.18	9.36	3.21	4.85**

** Significant at .01 level of confidence = 2.69

TABLE V

MEAN SCORES FOR INTELLIGENCE, TOTAL RHYTHMIC ABILITY, PRINTING, PHYSICAL EDUCATION, AND ARITHMETIC FOR GRADE ONE AND GRADE THREE

Number of pupils--100	Grade One--50			Grade Three--50			
Tests	Grade One			Grade Three			
	Range	Mean	S.D.	Range	Mean	S.D.	"t"
	A	B	C	D	E	F	G
1. Intelligence	85-124	104.12	10.12	89-122	106.98	8.14	1.54
2. Total Rhythmic Ability Score	35.5-77.5	54.24	9.93	53-83	68.39	7.79	7.85**
3. Printing or Writing (school test)	30-90	63.30	12.75	44-90	59.44	8.48	1.76
4. Physical Education (school test)	44-90	62.56	9.57	57-90	64.50	7.69	1.11
5. Arithmetic (school test)	30-90	65.08	15.69	30-90	64.26	13.59	.28

* Significant at .05 level of confidence = 1.99

** Significant at .01 level of confidence = 2.63

except for the slight superiority of the grade one children in printing, each grade had reached a comparable level of achievement in these subjects, according to its grade requirements.

According to the results indicated in Table V, a highly significant difference at the one percent level of confidence existed between the means for each grade, for Total Rhythmic Ability (Grade 1 Mean 54.24; Grade 3 Mean 68.39). The superiority of the grade three children suggested that rhythmic ability, as measured by the Total Rhythmic Ability Score, tended to improve with age and experience, although examination of the range of scores for each grade showed an overlap (Grade 1 Range 35.5-77.5; Grade 3 Range 53-83). This overlapping of scores between grades indicated that there was a wide range in ability at each grade level, and that some children either have or acquire these abilities much earlier than others.

Rhythmic Abilities and Reading Achievement

Table VI presents the means and standard deviations for each grade for each of the rhythmic ability sub-tests. Closer examination of the differences between the grade one and the grade three performances on tests within the Total Rhythmic Ability Battery revealed that eight of the nine sub-tests had significantly higher

TABLE VI

MEAN SCORES FOR RHYTHMIC ABILITY TESTS
FOR GRADE ONE AND GRADE THREE

Number of pupils--100		Grade One--50			Grade Three--50		
Tests	Grade One Range	Mean	S.D.	Grade Three Range	Mean	S.D.	"t"
	A	B	C	D	E	F	G
1. Jumping	2-8	5.28	1.83	4-8	6.66	1.49	4.09**
2. Circle Drawing	5-10	8.20	1.10	4-10	8.68	1.22	2.05*
3. Double Circle	0-9	5.64	2.12	1-9	6.18	1.93	1.32
4. Rhythmic Writing	3-10.5	6.36	2.09	7-12	10.08	1.21	10.76**
5. Rhythmic Designs	2-7	4.78	1.49	3-7	6.02	1.06	4.76**
6. Auditory-Motor Match	4-17	9.96	3.09	8-18	12.78	2.52	4.95**
7. Knox Cube Imitation Test	1-7	5.66	1.41	3-10	6.80	1.55	3.81**
8. Auditory-Visual Integration	1-9	5.58	1.90	3-10	7.46	1.84	4.98**
9. Clapping	0-5	3.02	1.45	1-5	3.80	1.00	3.10**

* Significant at .05 level of confidence = 1.99

** Significant at .01 level of confidence = 2.63

means for the grade three children, indicating the superior ability of the older children in these areas. These tests, in descending order of the size of the differences between the means for grade one and grade three, were: (1) Rhythmic Writing, (2) Auditory-Visual Integration, (3) Auditory-Motor Match, (4) Rhythmic Designs, (5) Jumping, (6) Knox Cube Imitation Test, (7) Clapping, (8) Circle Drawing, and (9) Double Circle. Examination of the tests proceeded in the order of their effectiveness in discriminating between the two grades.

Rhythmic Writing. Table VI shows the difference between the means for each grade for this test is twice as great as any other single difference obtained for other rhythmic performances. The grade three children were much superior to the grade one children in the visual-motor abilities which were examined. A comparison of the standard deviations for each grade (Grade 1 S.D. 2.09; Grade 3 S.D. 1.21) indicated that there was more uniformity in the grade three performances than in the grade one performances. Training in cursive writing would have given the older children an obvious advantage over the younger children, as cursive letter forms were used for four of the six rhythmic writing patterns. According to these findings, the grade three children, through instruction, practice,and maturation of perceptual-motor

abilities showed a significant gain over grade one children in the ability to reproduce rhythmic movement patterns, as measured by the test Rhythmic Writing.

Auditory-Visual Integration. Table VI, page 66, indicated that there was a significant difference between the means for each grade for this test (Grade 1 Mean 5.58; Grade 3 Mean 7.46). Grade three children showed a significant gain over grade one children in the ability to interrelate auditory and visual stimuli.

Birch and Belmont (1965) used this test with normal children of above average intelligence and obtained the following results for the grades one and three children in their study:

Grade One	A-V Mean 5.6	S.D. 2.2	Range 1-9
Grade Three	A-V Mean 8.5	S.D. 1.9	Range 3-10

In another study, a sample of children of average ability, one year older than the grade three group just described, obtained a mean score of 7.2, standard deviation of 2.5 (Birch and Belmont, 1964). The findings from the present study were in general agreement with the information reported by Birch and Belmont. Although there appeared to be a developmental trend in this ability, the overlapping of scores between the grades, mentioned previously, revealed that there was a wide range of behavior in each grade.

Auditory-Motor Match. Table VI, page 66, indicated that a significant difference existed between the means for each grade for this test, in favor of grade three (Grade 1 Mean 9.96; Grade 3 Mean 12.78). The extensive overlap in the range of scores (Grade 1 Range 4-17; Grade 3 Range 8-18) indicated that there was a wide spread in ability at each grade level. Because the tests _Auditory-Motor Match_ and _Auditory-Visual Integration_ involved the auditory perception of patterns of sounds, it appeared likely that the skills involved were closely related. The close similarity of the differences between the means for each test suggested that they had been found to be of similar difficulty by each grade. However, in the test _Auditory-Motor Match_ the child tapped a pattern in response to the auditory signal, whereas in _Auditory-Visual Integration_ the child observed and listened to the tapped pattern and then matched it with a visual pattern of dots. Thus, although the test patterns were somewhat similar, the testing situation and the responses in each test were different. Examination of the intercorrelations of these tests was necessary to determine the extent of this relationship.

Rhythmic Designs. Table VI, page 66, indicated that there was a significant difference between the means for each grade for this test, in favor of grade three (Grade 1 Mean 4.78; Grade 3 Mean 6.02). This test

demanded that simple rhythmic patterns had to be spatially aligned as they were being reproduced. The considerable degree of overlap in the scores, with some children in each grade achieving perfect scores, indicated that the test did not provide enough challenge for the more capable children (Grade 1 Range 2-7; Grade 3 Range 3-7). However, as the range in scores showed, there were children in each grade who performed poorly. Examination within the grades was necessary to give insight as to the possible usefulness of the test.

<u>Jumping</u>. Grade three children showed superiority over grade one children in this measure of balance, as indicated in Table VI, page 66 (Grade 1 Mean 5.28; Grade 3 Mean 6.66). Jumping skill, considered to be related to age and sex according to studies by McCaskill (1938), Cron (1957), and others, showed improvement from grade one to grade three in this study. Differences in this ability were more clearly defined, in the present study, through an examination of differences between boys and girls within each grade.

<u>Knox Cube Imitation Test</u>. Table VI, page 66, showed that there was a significant difference between the means for this test for each grade (Grade 1 Mean 5.66; Grade 3 Mean 6.80). Grade three children were

better able to attend to and remember series of movements in which blocks were tapped by the examiner. This was interpreted to indicate that rhythmic ability, as measured by this test, showed improvement from grade one to grade three.

<u>Clapping</u>. Table VI, page 66, revealed that there was a significant difference between the means for this test for the two grades, in favor of the grade three children (Grade 1 Mean 3.02; Grade 3 Mean 3.80). This was a rather "informal" test which required that four hand clapping patterns be repeated by the child, and that the child clap in time to a nursery rhyme. Although the performances of the older children were better, the close similarity of the means indicated that the test, in its present form, was not a useful measure of differences in rhythmic ability between grades one and three.

<u>Circle Drawing</u>. This test, used as a measure of motor control in this study but based on criteria for directionality, showed a significant difference between the means for each grade, with the grade three children having better ability than the grade one children (Table VI, page 66). However, examination of the means indicated that the performances were not sufficiently different to be of use in distinguishing between the two grade levels (Grade 1 Mean 8.20; Grade 3 Mean 8.68).

The ability to perform adequately seemed to have matured in the younger children. Furthermore, the selection of children,with right lateral dominance only,contributed to the similarity in the circle drawing performances. This does not imply that the test, used as a diagnostic tool for the purpose intended by the test designer (Kephart, 1960), would not aid in identifying children with perceptual-motor handicaps.

Double Circle. Table VI, page 66, showed that no significant difference existed between the means for this test for the two grades, although a slight superiority was shown by the grade three children (Grade 1 Mean 5.64; Grade 3 Mean 6.18). This indicated that the test was not a useful measure of differences between the grades one and three children in this sample.

RELATIONSHIP BETWEEN RHYTHMIC ABILITY AND SCHOOL ACHIEVEMENT IN TOTAL GRADES

Through an examination of the means it had been established that significant differences existed between the performances of grade one and grade three children on a battery of tests of rhythmic ability. In order to assess the relationship between rhythmic ability test scores and the results of school achievement tests, intercorrelations were obtained between all tests for

each grade. The study of general rhythmic ability (as measured by the Total Rhythmic Ability Score) was followed by an analysis of the relationship between rhythmic ability sub-test scores and the scores from the reading tests for each grade.

Grade One

General Abilities. Table VII presents the inter-correlations which were obtained for chronological age, and scores for intelligence, general rhythmic ability, and school achievement tests. According to these results, general rhythmic ability had a moderately high relationship with the two measures of reading ability, with correlations of .62 and .60. This justified further analysis of rhythmic ability in relation to reading ability. A correlation of .82 between the two reading tests suggested that these tests were good measures of similar reading skills.

The relationship of rhythmic ability to the other school subjects included in this study was interpreted with less assurance. The subject scores were calculated by converting letter grades to scores and were therefore less discriminating than the other test scores. Correlations indicated in TableVII, page 74, suggested that rhythmic ability in grade one bore a higher relationship

TABLE VII

INTERCORRELATIONS BETWEEN GENERAL ABILITIES AND CHRONOLOGICAL AGE FOR GRADE ONE

N=50 Tests correlated with C.A.	C. A.	I. Q. Test	Total Rhythmic Ability Score	E.P.S.B. Word Test I	Gates PPR Test	Printing	Physical Education	Arithmetic
	A	B	C	D	E	F	G	H
1. C.A.		-.21	.14	.09	.01	.01	.12	.15
2. I.Q. Test			.37	.58	.57	.42	.17	.60
3. Total Rhythmic Ability Score				.62	.60	.32	.23	.53
4. E.P.S.B. Word Test I					.82	.36	.17	.79
5. Gates PPR Test						.33	.17	.64
6. Printing (school test)							.17	.40
7. Physical Education (school test)								.24
8. Arithmetic (school test)								

Significance at the .05 level of confidence —— = .28

Significance at the .01 level of confidence —— = .36

to arithmetic ability (.53), than to printing ability (.32), or physical education skills (.23).

Scores for rhythmic ability and intelligence tests had relatively equal correlations (ranging from .57 to .62) with the reading test scores. However, the correlation of .37 between rhythmic ability and intelligence scores suggested that the abilities examined, while associated, were not synonymous.

Intercorrelations between the subject areas indicated that, in grade one, test scores in the following areas were related: reading tests and arithmetic, .79 and .64; reading tests and printing, .36 and 33; printing and arithmetic, .40. Physical education scores had a low but positive relationship with each of the other subject scores.

These results were interpreted as indicating that rhythmic ability, reading, arithmetic, printing ability, and intelligence were significantly related in children in grade one, with rhythmic ability bearing a slightly higher relationship to reading achievement than to ability in other school subjects.

Rhythmic abilities and reading achievement. The correlations between the rhythmic ability sub-tests and intelligence and reading ability are recorded in Table VIII. Four of the rhythm sub-tests had correlations

TABLE VIII

INTERCORRELATIONS BETWEEN RHYTHMIC ABILITY SUB-TESTS, AND BETWEEN SUB-TESTS AND INTELLIGENCE, TOTAL RHYTHMIC ABILITY SCORE, AND READING ACHIEVEMENT TESTS FOR GRADE ONE

N=50 Tests correlated	Jumping A	Circle Drawing B	Double Circle C	Rhythmic Writing D	Rhythmic Designs E	Auditory-Motor Match F	Knox Cube Test G	Auditory-Visual Integration H	Clapping I
1. I. Q. Test	.28	-.02	-.07	.35	.33	.28	.13	.35	.15
2. E.P.S.B. Word Test I	.39	-.08	.08	.35	.37	.56	.11	.59	.46
3. Gates PPR Test	.50	-.003	.05	.43	.31	.57	.03	.56	.40
4. Total Rhythmic Ability Score	.60	.28	.35	.76	.44	.78	.24	.79	.55
5. Jumping		.002	.37	.44	.15	.37	-.16	.30	.37
6. Circle Drawing			-.12	.10	-.08	.24	.13	.35	.27
7. Double Circle				.14	.16	.10	-.08	.06	-.09
8. Rhythmic Writing					.48	.51	.28	.56	.26
9. Rhythmic Designs						.17	.18	.17	.01
10. Auditory-Motor Match							-.05	.66	.50
11. Knox Cube Imitation Test								.32	.03
12. Auditory-Visual Integration									.45
13. Clapping									

Significant at .05 level of confidence —— = .28

Significant at .01 level of confidence —— = .36

with intelligence tests at the five percent level of confidence: (1) Auditory-Visual Integration .35; (2) Rhythmic Writing .35; (3) Rhythmic Designs .33; and (4) Auditory-Motor Match .28. Of the nine rhythmic ability sub-tests, six had significant correlations, some reaching the one percent level of confidence, with the two reading tests, E.P.S.B. Word Test I and Gates Paragraph Meaning Test. The tests which appeared to have close associations with reading (with the first correlation indicating the relationship with E.P.S.B. Word Test I) were: (1) Auditory-Visual Integration .59, .56; (2) Auditory-Motor Match .56, .57; (3) Jumping .39, .50; (4) Clapping .46, .40; (5) Rhythmic Writing .35, .43; and (6) Rhythmic Designs .37, .31. Of these six tests, the two tests which depended on auditory perception of a tapped pattern had the highest correlations with reading ability. These were followed by the tests of balance and clapping--both measures of the degree of integration between the two sides of the body. The correlations between reading and the two rhythmic visual-motor tasks were somewhat lower but met the level of confidence set in this study. A negligible relationship between reading achievement and the three remaining tests was indicated by the following correlations: Circle Drawing -.08, -.003; Double Circle Test .08, .05; and

Knox Cube Imitation Test .11, .03.

These results suggested that selected tests of rhythmic ability (auditory-visual, auditory-motor, and visual-motor) and measures of balance and clapping skill bore a positive relationship to the level of success in reading in grade one.

Because the Total Rhythmic Ability Score showed significant correlations with the two reading tests in grade one (Table VII, page 74), the relationship of each sub-test to the Total Rhythmic Ability Score was examined to determine which single test, or series of tests, might prove to be the most effective measure of general rhythmic ability. An appraisal of the correlations shown in Table VIII, page 76, indicated that the highest correlations were found between the Total Rhythmic Ability Score and the following tests: (1) Auditory-Visual Integration .79; (2) Auditory-Motor Match .78; (3) Rhythmic Writing .76; (4) Jumping .60; (5) Clapping .55; (6) Rhythmic Designs .44. These correlations suggested that use of the first four tests gave an adequate measure of rhythmic ability in grade one.

Grade Three

General abilities. Table IX shows that, in

TABLE IX

INTERCORRELATIONS BETWEEN GENERAL ABILITIES AND CHRONOLOGICAL AGE FOR GRADE THREE

N=50

Tests correlated with C.A.	C. A.	I. Q.	Total Rhythmic Ability Score	E.P.S.B. Word Test III	Gates ND Test	Gates GS Test	Printing	Physical Education	Arithmetic
	A	B	C	D	E	F	G	H	I
1. C. A.		-.08	.08	-.17	.05	-.26	.02	.10	-.16
2. I. Q. Test			.25	.25	.16	.24	.39	.32	.37
3. Total Rhythmic Ability Score				.53	.48	.35	.28	.35	.45
4. E.P.S.B. Word Test III					.57	.59	.38	.23	.55
5. Gates ND Test						.69	.44	.28	.49
6. Gates GS Test							.47	.10	.31
7. Printing (school test)								.19	.28
8. Physical Education (school test)									.47
9. Arithmetic (school test)									

Significant at the .05 level of confidence —— = .28

Significant at the .01 level of confidence —— = .36

grade three, the Total Rhythmic Ability Score had a closer relationship with two of the three reading tests which were administered to this grade, than with other achievement tests (E.P.S.B. III, r = .53; Gates ND, r = .48; Gates GS, r = .35). However, a significant association was also observed between rhythmic ability and arithmetic (r = .45), physical education (r = .35) and school writing (r = .28).

The most significant intercorrelations in or between the subject areas were between the three tests of reading (.57, .59, .69), between reading and arithmetic (.55, .49, .31), between reading and school writing (.38, .44, .47) and between arithmetic and physical education (.47). This suggested that the capable performers in one subject tended to do well in other subjects also.

The correlation between the Total Rhythmic Ability Score and intelligence scores (.25) suggested that intelligence did not affect significantly the general level of rhythmic ability in this sample of grade three children. It was interesting to note that the relationship of intelligence to the three reading tests (r = .25, .16, .24) was very similar to that between intelligence and rhythmic ability. These results were interpreted to indicate that, in grade three, general rhythmic ability might be associated with achievement in reading, arithmetic, and physical education, and to a lesser degree

with school writing and intelligence.

Rhythmic abilities and reading achievement. Table X shows the correlations of the rhythmic ability sub-test scores with reading and intelligence scores. Only one sub-test--Rhythmic Designs--had a significant association with intelligence (r = .30). The individual tests in the rhythmic battery had the following correlations with the scores from the E.P.S.B. Word Test III, Gates ND Test, and Gates GS Test respectively:

1. Three significant correlations with reading:
   Auditory-Motor Match (.50, .39, .31)

2. Two significant correlations with reading:
   Auditory-Visual Integration (.48, .34, .27)
   Knox Cube Imitation Test (.25, .40, .31)

3. One significant correlation with reading:
   Clapping (.37, .16, .000)
   Rhythmic Writing (.25, .36, .14)
   Jumping (.30, .18, .05)
   Rhythmic Designs (.18, .23, .29)

4. Two correlations approaching a level of significance:
   Circle Drawing (.27, .21, .27)

5. Negligible correlations with reading:
   Double Circle (-.05, .06, .01)

These results suggested that whereas the Total Rhythmic Ability Battery might test abilities which were common to reading, these abilities, with the possible exceptions of those listed in 1. and 2., were not strongly associated with success in reading in grade three. However, because of positive tendencies to relate with

TABLE X

INTERCORRELATIONS BETWEEN RHYTHMIC ABILITY SUB-TESTS, AND BETWEEN SUB-TESTS AND INTELLIGENCE, TOTAL RHYTHMIC ABILITY SCORE, AND READING ACHIEVEMENT TESTS FOR GRADE THREE

N=50

Tests correlated	Jumping A	Circle Drawing B	Double Circle C	Rhythmic Writing D	Rhythmic Designs E	Auditory-Motor Match F	Knox Cube Test G	Auditory-Visual Integration H	Clapping I
1. I. Q. Test	.02	.16	.03	.03	.30	.23	.12	.15	.26
2. E.P.S.B. Word Test III	.30	.27	-.05	.25	.18	.50	.25	.48	.37
3. Gates ND Test	.18	.21	.06	.36	.23	.39	.40	.34	.16
4. Gates GS Test	.05	.27	.01	.14	.29	.31	.31	.27	.000
5. Total Rhythmic Ability Score	.47	.48	.40	.62	.28	.84	.41	.65	.71
6. Jumping		.16	.06	.46	.14	.27	-.04	.07	.41
7. Circle Drawing			.17	.30	-.01	.27	.07	.30	.26
8. Double Circle				.09	-.10	.26	-.08	.11	.23
9. Rhythmic Writing					.16	.42	.20	.18	.52
10. Rhythmic Designs						.20	.14	.08	.04
11. Auditory-Motor Match							.25	.59	.57
12. Knox Cube Imitation Test								.21	.21
13. Auditor-Visual Integration									.38
14. Clapping									

Significant at the .05 level of confidence = .28

Significant at the .01 level of confidence = .36

reading scores exhibited by the majority of the rhythmic ability sub-tests, the possibility existed that these abilities had been more closely associated with reading achievement in the earlier grades.

An important finding was that of all the rhythm sub-tests, the two auditory tests--Auditory-Motor Match and Auditory-Visual Integration--bore the highest relationship to reading achievement. In addition, the tests of auditory perception had close associations with arithmetic ability (Auditory-Motor Match, $r = .41$; Auditory-Visual Integration, $r = .40$). The abilities which were being measured in the auditory tests seemed to be related to attention span and to the ability to recognize patterns, aptitudes which may have similar significance for reading and arithmetic achievement.

Table X showed that the following tests correlated most highly with the Total Rhythmic Ability Score in grade three, and could thus serve as adequate measures of it: (1) Auditory-Motor Match ($r = .84$); (2) Clapping ($r = .71$); (3) Auditory-Visual Integration ($r = .65$; (4) Rhythmic Writing ($r = .62$). The significant relationship of Auditory-Motor Match to reading tests and to the Total Rhythmic Ability Score would recommend its use in measuring aptitudes which were associated with both reading and rhythmic ability.

COMPARISON OF RELATIONSHIPS BETWEEN RHYTHMIC ABILITY AND SCHOOL ACHIEVEMENT

General Abilities

A comparison between grades one and three, based on the intercorrelations recorded in Table VII, page 74, and Table IX, page 79, resulted in the following observations with respect to the performances of the children tested in this study:

1. Rhythmic ability appeared to be more closely related to reading achievement in grade one than in grade three. For grade one, correlations of .62 and .60 were obtained between the Total Rhythmic Ability Battery and the E.P.S.B. Word Test I and Gates PPR Test respectively. For grade three, correlations between the Total Rhythmic Ability Battery and E.P.S.B. Word Test III, Gates ND Test, and Gates GS Test, were .53, .48, and .35 respectively.

2. Reading ability in both grades showed a positive relationship with arithmetic, and printing or school writing. The relationship between reading and arithmetic was more pronounced in grade one than in grade three, with correlations of .79 and .64 being obtained for arithmetic and two reading tests in grade one, and correlations of .55, .49, and .31 between arithmetic and three reading tests in grade three.

The correlations between printing and two reading tests in grade one were .36 and .33, but for grade three a slightly closer association between reading and school writing was suggested by the correlations of .38, .44 and .47.

3. Rhythmic ability in both grades showed a consistent positive relationship with the school subjects arithmetic, printing or school writing ability, and physical education skills, as shown by the following correlations:

	Arithmetic	Writing	Physical Education
Grade One Total Rhythmic Score	.53	.32	.23
Grade Three Total Rhythmic Score	.45	.28	.35

4. Rhythmic ability had a significant relationship with intelligence (r = .37) in grade one, but in grade three the association was lower and did not meet the level of confidence (r = .25).

Rhythmic Abilities and Reading Achievement

The relationship between the rhythmic sub-tests and tests of reading ability was more pronounced in grade one than in grade three; six sub-tests showed significant correlations with reading tests in grade one, but in grade three only three sub-tests had consistent and positive associations with reading tests. Table XI

TABLE XI

INTERCORRELATIONS BETWEEN RHYTHMIC ABILITY SUB-TESTS AND READING TESTS FOR GRADE ONE AND GRADE THREE

Number of Pupils	Grade One--50		Grade Three--50		
Tests correlated	Grade One		Grade Three		
	EPSB Test 1	Gates PPR	EPSB Test III	Gates ND	Gates GS
	A	B	C	D	E
1. Jumping	.39	.50	.30	.18	.05
2. Circle Drawing	-.08	-.003	.27	.21	.27
3. Double Circle	.08	.05	-.05	.06	.01
4. Rhythmic Writing	.35	.43	.25	.36	.14
5. Rhythmic Designs	.37	.31	.18	.23	.29
6. Auditory-Motor Match	.56	.57	.50	.39	.31
7. Knox Cube Imitation Test	.11	.03	.25	.40	.31
8. Auditory-Visual Integration	.59	.56	.48	.34	.27
9. Clapping	.46	.40	.37	.16	.000

Significant at .05 level of confidence ——— = .28

Significant at .01 level of confidence ——— = .36

indicates that, in grade one, the abilities tested in the following rhythmic tests might have importance for reading--a conclusion based on the strength of their correlations with two reading tests: (1) Auditory-Visual Integration .59, .56; (2) Auditory-Motor Match .56, .57; (3) Jumping .39, .50; (4) Clapping .46, .40; (5) Rhythmic Writing .35, .43; (6) Rhythmic Designs .37, .31. In grade three, the rhythm sub-tests having the highest correlations with the three reading tests were: (1) Auditory-Motor Match .50, .39, .31; (2) Auditory-Visual Integration .48, .34, .27; (3) Knox Cube Imitation Test .25, .40, .31. Tests involving auditory perception and/or auditory memory had the highest relationship with reading ability in each grade.

As indicated in Table VIII, page 76, the sub-tests in the rhythm battery which had the highest correlations with the Total Rhythmic Ability Score in grade one were: (1) Auditory-Visual Integration .79; (2) Auditory-Motor Match .78; (3) Rhythmic Writing .76; (4) Jumping .60. In grade three, the sub-tests which were most closely related with the total score were: (1) Auditory-Motor Match .84; (2) Clapping .71; (3) Auditory-Visual Integration .65; (4) Rhythmic Writing .62 (Table X, page 82). These results indicated that rhythmic ability could be effectively measured in both grades by the use of

auditory-motor, auditory-visual, and visual-motor tests.

Auditory-Motor Match. This test had significant correlations with reading tests in both grades, with correlations of .56 and .57 in grade one, and correlations ranging from .31 to .50 in grade three (Table XI, page 86). The test appeared to serve as a measure of attention and of ability to recognize and momentarily retain a pattern of sounds. This ability appeared to have a more consistent relationship with reading achievement at the grade one level than at the grade three level.

Auditory-Visual Integration. This test had a slightly higher correlation with reading ability at the grade one level than at the grade three level, with correlations of .56 and .59 in grade one, and correlations ranging from .27 to .48 in grade three (Table XI, page 86). The relationship of this test to reading ability was very similar to that of the test Auditory-Motor Match and reading tests. The similarity between these tests, which was noted in the comparison of the means, was supported by the correlations between them, of .66 in grade one (Table VIII, page 76) and .59 in grade three (Table X, page 82). This suggested that if a child could reproduce a pattern by tapping, he was likely to be able to match an auditory pattern with a visual pattern, and the

converse. Attention, auditory memory, and ability to recode information seemed to be common factors in these tests.

Jumping. Table XI, page 86, showed that this test of balance and integrated movements had a significant relationship with two tests of reading achievement in grade one ($r = .39, .50$) but a much less consistent association with the three tests of reading in grade three ($r = .30, .18, .05$). These results suggested that tests of jumping would be useful measures of rhythmic ability in grade one (supplemented by other tests), and that a deficiency in this ability might have considerable diagnostic importance.

Rhythmic Writing. This test had a higher relationship with reading in grade one than in grade three, with correlations of .35 and .43 in grade one, and correlations ranging from .14 to .36 in grade three (Table XI, page 86). Instruction and practice in cursive writing, in which the grade three children had had experience, made their performances more uniform and the correlations less informative. In both grades, scores in Jumping and Rhythmic Writing had a clear relationship, the correlation between tests in grade one being .44, and in grade three .46 (Table VIII, page 76, and Table X, page 82).

These findings supported the work of Kephart and others who postulate a relationship between balance, posture, and other movements.

Rhythmic Designs. This test showed a higher relationship with the two reading tests in grade one (r = .37 and .31) than with the three reading tests in grade three (r = .18, .23, .29), although a consistent and positive association was evident in this grade (Table XI, page 86). These correlations with reading were rather similar to those between Rhythmic Writing and reading. However, although Rhythmic Writing and Rhythmic Designs had a correlation of .48 in grade one (Table VIII, page 76), this was reduced to .16 in grade three (Table X, page 82). This suggested that the spatial judgments which were made in these tests posed similar problems for the grade one child, but that these judgments differed for the grade three child. The older child could rely on practised movements for the writing patterns, but had to make new observations in the designs test.

Clapping. This test had a close association with the two reading tests in grade one (r = .46, .40), but the association in grade three (r = .37, .16, .000) indicated a negligible or inconsistent relationship (Table XI, page 86). In both grades, correlations were consistent between Clapping and Jumping (.37, .41)--

tests which demanded integrated movements which involved both sides of the body (Table VIII, page 76, and Table X, page 82).

Circle Drawing. This test, a measure of motor control, showed a stronger tendency to relate to reading tests at the grade three level than at the grade one level where relationships were inconsistent (Table XI, page 86). Examination of the means had indicated that performances in grade three were fairly uniform. The performance of grade one children in activities involving motor control tend to be erratic and this would result in no consistency in the relationships.

Double Circle. Table XI, page 86, indicated that this test had low correlations with all reading tests in both grades. The test had been expected to show an association with other tests of bilateral activity (Jumping and Clapping) but did not do so except in the case of grade one jumping ($r = .37$; Table VIII, page 76.

Knox Cube Imitation Test. This test, a measure of memory for movements, showed low associations with reading and all other tests in grade one except Rhythmic Writing and Auditory-Visual Integration (Table VIII, page 76). However, in grade three positive relationships were observed between the Knox Test and the three tests

of reading (r = .25, .40, .31; Table XI, page 86). The test may have served as a measure of attention span in grade three; in grade one, the tendency of some children to reverse the movements demonstrated by the examiner resulted in lower scores.

COMPARISON OF RHYTHMIC ABILITY IN HIGH AND LOW READING GROUPS WITHIN THE GRADES

The high and low reading ability groups within each grade were examined for the purpose of noting significant differences and trends in the relationship of rhythmic ability to reading achievement--a relationship which was hypothesized following the analysis of the performances of the total grades. A comparison was made of the means, standard deviations, and correlations for all tests for high and low reading ability groups.

Grade One High and Low Reading Ability Groups

A comparison between the high and low reading ability groups in grade one, referred to as High Group 1 and Low Group 1 in subsequent discussion, indicated that these groups differed significantly from each other, not only in reading, but also in rhythmic ability, intelligence, and printing and arithmetic ability, with High Group 1 showing superiority in all cases. Table XII presents a summary of the means for general abilities

TABLE XII

SUMMARY OF MEANS FOR GENERAL ABILITIES AND CHRONOLOGICAL AGE
FOR HIGH AND LOW READING ABILITY GROUPS IN GRADE ONE

Number of Pupils--50		High Group 1--25			Low Group 1--25		
Tests	High Group 1			Low Group 1			
	Range	Mean	S.D.	Range	Mean	S.D.	"t"
	A	B	C	D	E	F	G
1. C. A. (months)	77-90	83.80	3.53	78-89	83.24	3.04	0.59
2. I. Q. Test	94-124	110.32	7.37	85-114	97.92	8.59	5.37**
3. Total Rhythmic Ability Test	44.5-77.5	60.76	8.53	36.5-60.5	47.72	6.26	6.03**
4. E.P.S.B. Word Test I	71-100	87.20	8.31	24-70	49.72	13.38	11.66**
5. Gates PPR Test	18-25	22.76	1.84	6-24	16.60	3.76	7.20**
6. Printing (school test)	44-90	69.08	12.02	30-72	57.52	10.66	3.52**
7. Physical Education (school test)	44-76	63.40	8.70	44-90	61.72	10.29	0.61
8. Arithmetic (school test)	57-90	76.64	9.51	30-72	53.52	11.61	7.55**

** Significant at .01 level of confidence = 2.69

and chronological age for high and low reading groups. Good readers tended to score higher than poor readers in tests involving rhythm (High Group 1 Mean 60.76; Low Group 1 Mean 47.72). However, the difference between the means for the total rhythm performance ($t = 6.03$) indicated that the groups did not vary as greatly in this ability as they did in reading ($t = 11.66$, 7.20) or in arithmetic ($t = 7.55$). In addition, although the reading performances were more consistent in High Group 1 than in Low Group 1 (E.P.S.B. Test: High Group 1 S.D. 8.31, Low Group 1 S.D. 13.38; Gates PPR Test: High Group 1 S.D. 1.84, Low Group 1 S.D. 3.76), the rhythmic performances showed greater variation among the good readers than among the poor readers (High Group 1 S.D. 8.53; Low Group 1 S.D. 6.26). This finding suggested that rhythmic ability bore a generalized rather than a specific relationship to reading achievement. However, it was evident that rhythmic ability reflected the general level of achievement and ability of the two groups.

In the total grade one (Table VII, page 74), rhythmic ability had a closer association with reading ($r = .62$, $.60$) and arithmetic ability ($r = .53$) than with printing ($r = .32$) or physical education ($r = .23$). However, Table XIII and Table XIV, page 96, which indicate the correlations between test scores for general

TABLE XIII

INTERCORRELATIONS BETWEEN GENERAL ABILITIES AND CHRONOLOGICAL AGE FOR HIGH READING ABILITY GROUP, GRADE ONE

N=25 Tests correlated with C.A.	C.A.	I.Q. Test	Total Rhythmic Ability Score	E.P.S.B. Word Test I	Gates PPR Test	Printing	Physical Education	Arithmetic
	A	B	C	D	E	F	G	H
1. C. A.		-.40	.03	.01	.02	-.18	.17	.09
2. I. Q. Test			-.09	.17	.39	.40	.25	.26
3. Total Rhythmic Ability Score				-.06	.19	.11	.22	-.22
4. E.P.S.B. Word Test I					.52	-.18	-.23	.31
5. Gates PPR						.02	.02	.21
6. Printing (school test)							.34	.17
7. Physical Education (school test)								.22
8. Arithmetic (school test)								

Significant at .05 level of confidence —— = .40

Significant at .01 level of confidence —— = .50

TABLE XIV

INTERCORRELATIONS BETWEEN GENERAL ABILITIES AND CHRONOLOGICAL AGE FOR LOW READING ABILITY GROUP, GRADE ONE

N=25 Tests correlated with C.A.	C.A.	I.Q.	Total Rhythmic Ability Score	E.P.S.B.Word Test I	Gates PPR Test	Printing	Physical Education	Arithmetic
	A	B	C	D	E	F	G	H
1. C.A.		-.28	.25	.07	-.14	.17	.06	.18
2. I.Q. Test			-.03	.13	.19	.01	.07	.29
3. Total Rhythmic Ability Score				.35	.35	-.09	.26	.46
4. E.P.S.B. Word Test I					.57	.01	.41	.55
5. Gates PPR Test						.001	.21	.25
6. Printing (school test)							-.03	.07
7. Physical Education (school test)								.30
8. Arithmetic (school test)								

Significant at .05 level of confidence —— = .40

Significant at .01 level of confidence —— = .50

abilities, show that there were some consistent differences between the relationship of rhythmic ability scores and reading achievement scores for High Group 1 and Low Group 1. For the good readers, the correlations of -.06 and .19 suggested a low negligible association between rhythmic ability and reading; for the poor readers, a positive, consistent relationship was shown with correlations of .35 and .35 (Table XIII, page 95, Table XIV). Correlations between the Total Rhythmic Ability Score and arithmetic tests showed even greater differences: for the good readers a fairly strong negative association was evident (r = -.22), but for the poor readers arithmetic and rhythmic ability were significantly related at the five percent level of confidence, with a correlation of .46. Rhythmic ability scores bore a fairly similar relationship in both groups to printing (High Group 1, r = 11; Low Group 1, r = -.09) physical education (High Group 1, r = .22, Low Group 1, r = .26) and intelligence (High Group 1, r = -.09, Low Group 1, r = -.03). Thus the Total Rhythmic Ability Score had a stronger relationship with arithmetic and reading scores in Low Group 1--a relationship which was not evident in High Group 1. However, because the means for the good readers were significantly higher than the means for the poor readers for the total

rhythmic performance (Table XII, page 93) the possibility existed that there was a certain minimum level of rhythmic ability which was important, or even necessary, for early success in reading and arithmetic; however, if this level had been reached prior to, or concurrently with, beginning instruction, it may no longer have a direct bearing on achievement. The relationship of rhythmic ability to reading found between the poor readers' test scores, together with their poorer performances in these tests, suggested that rhythmic aptitudes had significance for learning to read.

Examination of the performances of the grade one children on the rhythmic ability sub-tests, identified some specific areas of difference between the two groups. Table XV shows the means and standard deviations for the high and low reading groups for the nine rhythmic sub-tests. Six of the sub-tests had significant differences between the means for the two groups, in favor of the good readers--four at the one percent level of confidence: (1) Auditory-Visual Integration, (2) Rhythmic Designs, (3) Auditory-Motor Match, (4) Rhythmic Writing, and two at the five percent level of confidence: (1) Jumping, and (2) Clapping. The superiority of the good readers in tests of auditory-visual, visual-motor, and auditory-motor abilities, and in general motor control, suggested that their ability to recognize and respond to patterns was

TABLE XV

MEANS FOR RHYTHMIC ABILITY SUB-TESTS FOR HIGH AND LOW READING ABILITY GROUPS IN GRADE ONE

Number of pupils--50	High Group--25			Low Group--25			
	High Group 1			Low Group 1			
Tests	Range	Mean	S.D.	Range	Mean	S.D.	"t"
	A	B	C	D	E	F	G
1. Jumping	2-8	5.92	1.65	2-8	4.64	1.79	2.58*
2. Circle Drawing	6-9	8.12	0.77	5-10	8.28	1.34	0.51
3. Double Circle	1-9	5.92	2.13	0-9	5.36	2.08	0.92
4. Rhythmic Writing	3.5-10.5	7.38	2.12	3.0-8.0	5.34	1.48	3.87**
5. Rhythmic Designs	2.5-7.0	5.56	1.29	2.0-6.0	4.00	1.24	4.27**
6. Auditory-Motor Match	8-17	11.52	2.74	4-15	8.40	2.58	4.06**
7. Knox Cube Imitation Test	4-9	6.00	1.20	1-7	5.32	1.52	1.72
8. Auditory - Visual Integration	4-9	6.80	1.47	1-7	4.36	1.44	5.81**
9. Clapping	1-5	3.44	1.20	0-5	2.60	1.55	2.10*

* Significant at .05 level of confidence = 2.01

** Significant at .01 level of confidence = 2.69

similarly high in all these areas. There was no evidence that the poor readers in grade one, as a group, had an advantage in any single sensory-motor area, although their ability in the elementary skills of drawing circles and in reproducing a sequence of movements (using motor, visual, and auditory cues as in the Knox Test) was not significantly different from that of the good readers.

The performances on the sub-tests were examined in the order of their importance, determined by the magnitude of the difference between the means, and supplemented by an assessment of their correlations with reading achievement tests. Table XVI and Table XVII, page 102, show the intercorrelations between tests for High Group 1 and Low Group 1 respectively.

Auditory-Visual Integration. This test was most effective in identifying an ability in which the poor readers were deficient. A significant difference, at the one percent level of confidence, existed between the means for the two groups (High Group Mean 6.80; Low Group Mean 4.36) in favor of the good readers (Table XV). Despite the addition in this study of an extra trial with the sample items, the ability of the poor readers (indicated by the mean) was little better than that of the kindergarten children (Kindergarten Mean 4.1) in the normal population examined by Birch and Belmont (1965). Birch

TABLE XVI

INTERCORRELATIONS BETWEEN RHYTHMIC ABILITY SUB-TESTS, AND BETWEEN SUB-TESTS AND INTELLIGENCE, TOTAL RHYTHMIC ABILITY SCORE, AND READING ACHIEVEMENT TESTS FOR HIGH READING ABILITY GROUP, GRADE ONE

N=25 Tests correlated	Jumping	Circle Drawing	Double Circle	Rhythmic Writing	Rhythmic Designs	Auditory-Motor Match	Knox Cube Test	Auditory-Visual Integration	Clapping
	A	B	C	D	E	F	G	H	I
1. I. Q. Test	-.05	.35	-.28	-.15	.07	-.07	.05	-.08	-.07
2. E.P.S.B. Word Test I	-.16	.01	.01	-.34	-.01	.27	-.20	-.11	.15
3. Gates PPR Test	.12	.25	.03	.02	.25	.23	.22	-.003	-.007
4. Total Rhythmic Ability Score	.58	.44	.57	.78	.43	.74	.10	.60	.52
5. Jumping		.17	.59	.38	.35	.23	-.28	.13	.18
6. Circle Drawing			.01	.38	.17	.24	.000	.45	.25
7. Double Circle				.18	-.05	.39	-.12	.21	.12
8. Rhythmic Writing					.58	.40	.26	.45	.30
9. Rhythmic Designs						.15	.18	-.14	.16
10. Auditory-Motor Match							-.16	.43	.43
11. Knox Cube Imitation Test								.16	-.14
12. Auditory-Visual Integration									.32
13. Clapping									

Significant at .05 level of confidence —— = .40

Significant at .01 level of confidence —— = .50

TABLE XVII

INTERCORRELATIONS BETWEEN RHYTHMIC ABILITY SUB-TESTS, AND BETWEEN SUB-TESTS AND INTELLIGENCE, TOTAL RHYTHMIC ABILITY SCORE, AND READING ACHIEVEMENT TESTS FOR LOW READING ABILITY GROUP, GRADE ONE

N=25 Tests correlated	Jumping	Circle Drawing	Double Circle	Rhythmic Writing	Rhythmic Designs	Auditory-Motor Match	Knox Cube Test	Auditory-Visual Integration	Clapping
	A	B	C	D	E	F	G	H	I
1. I. Q. Test	.20	-.12	-.11	-.35	-.04	-.03	-.08	-.07	-.005
2. E.P.S.B. Word Test I	.41	-.04	-.12	-.01	-.29	.32	-.20	.21	.58
3. Gates PPR Test	.52	.02	-.11	.24	-.31	.44	-.38	.28	.40
4. Total Rhythmic Ability Score	.48	.51	.05	.47	-.23	.63	.13	.69	.52
5. Jumping		-.04	.13	.30	-.41	.26	-.25	.10	.38
6. Circle Drawing			-.19	.002	-.19	.41	.23	.59	.34
7. Double Circle				-.05	.28	-.33	-.11	-.28	-.34
8. Rhythmic Writing					-.11	.27	.14	.26	-.002
9. Rhythmic Designs						-.42	-.03	-.39	-.45
10. Auditory-Motor Match							-.26	.60	.44
11. Knox Cube Imitation Test								.28	.02
12. Auditory-Visual Integration									.41
13. Clapping									

Significant at .05 level of confidence ——— = .40

Significant at .01 level of confidence ——— = .50

stated that a mean of 4.1, on a test involving a comparatively small number of items, was only slightly better than chance expectancy.

Although the relationship of this test with reading achievement scores appeared, for the good readers, to be very low or negative ($r = -.11, -.003$), a positive association ($r = .21, .28$) existed between Auditory-Visual Integration and the two reading tests, for the poor readers (Table XVI, page 101, and Table XVII).

The implication was that lack of ability to recognize that an auditory pattern could be translated into a visual pattern handicapped the Low Group 1 in both reading and the test of auditory-visual integration, and that this deficiency existed at a very basic and elementary level.

Rhythmic Designs. A significant difference at the one percent level of confidence existed between the means for this test for High Group 1 and Low Group 1 (High Group 1 Mean 5.56; Low Group 1 Mean 4.00), with the good readers showing superiority (Table XV, page 99). The range in scores for the groups overlapped (High Group 1 Range 2.5 - 7.0; Low Group 1 Range 2.0 - 6.0) indicating that a successful performance did not necessarily indicate good reading ability. The task was not challenging for some of the good readers who achieved perfect scores.

The intercorrelations between this test and reading tests (Table XVI, page 101, and Table XVII, page 102) did not indicate that the ability tested was closely associated with reading at this grade level. However the test revealed that children in grade one varied greatly in the ability to perceive spatial relationships.

<u>Auditory-Motor Match</u>. Table XV, page 99, showed that a significant difference at the one percent level of confidence existed between the means for High Group 1 and Low Group 1 for this test (High Group 1 Mean 11.52; Low Group 1 Mean 8.40) with the good readers showing superiority. An examination of the range in scores for each group (High Group 1 Range 8-17; Low Group 1 Range 4-15) indicated that some of the poor readers were particularly weak in this ability.

An important finding from an appraisal of Table XVI, page 101, and Table XVII, page 102, was that this was the only rhythmic ability test which had a consistent positive correlation with the two reading tests for each ability group (High Group 1, $r = .27, .23$; Low Group 1, $r = .32, .44$). This might have been due to the greater range of difficulty in the test which made it more discriminating for children of good reading ability. Nevertheless, the results of this comparison directed attention to the importance of good auditory perception

of patterns for early success in reading.

<u>Rhythmic Writing</u>. A significant difference at the one percent level of confidence existed between the performances in this test by children in the grade one reading ability groups (High Group 1 Mean 7.38; Low Group 1 Mean 5.34), with the good readers displaying superior visual-motor ability (Table XV, page 99). A comparison between the intercorrelations between rhythmic writing and reading scores (Table XVI, page 101, and Table XVII, page 102), for these two groups, suggested that consistent differences were present, that the ability was of more significance for poor readers than for good readers (High Group 1, r = -.34, .02; Low Group 1, r = -.01, .24), and that this test was more closely related to reading test scores than was <u>Rhythmic Designs</u>.

<u>Jumping</u>. A significant difference at the five percent level of confidence existed between the means for this test for the good and poor readers (High Group 1 Mean 5.92; Low Group 1 Mean 4.64), with the good readers showing superiority in jumping tasks (Table XV, page 99). According to norms from developmental scales (McCaskill, 1938, and others) the first five of the eight skills examined in this test were normally acquired by children by the time they enter school, although there was a wide range of ability present in a normal population. The mean of 4.64

for the poor readers in this study suggested that a number of children in this group were backward in simple motor skills, although the range in scores (High Group 1 Range 2-8; Low Group 1 Range 2-8) indicated that there were children in High Group 1 who were similarly handicapped. The intercorrelations between jumping and reading tests (High Group 1, r = -.16, .12; Low Group 1, r = .41, .52), together with the lower means for Low Group 1, suggested that poor readers were less able than good readers in measures of balance and integrated movements, and that evaluation of motor skills would have some significance for diagnosing reading problems (Table XVI, page 101, and Table XVII, page 102).

Clapping. Table XV, page 99, revealed that a significant difference at the five percent level of confidence existed between the means for good and poor readers for this test (High Group 1 Mean 3.44; Low Group 1 Mean 2.60) in favor of the good readers. Although the correlations between this test and reading test scores must be interpreted with caution due to the brevity of the test, the highly significant relationship between the test scores for the poor readers (Low Group 1, r = .58, .40) suggested that a test of ability to clap patterns might aid in identifying poor readers (Table XVI, page 101, and Table XVII, page 102). However, the close similarity of

the actual scores (indicated by the means) suggested that the test needed revision in order to discriminate more effectively between children who are good or poor in this ability.

Knox Cube Imitation Test. There was not a significant difference between the means for this test for good and poor readers (High Group 1 Mean 6.00; Low Group 1 Mean 5.32) although the good readers tended to perform more ably (Table XV, page 99).

Double Circle Test. The performances of the two groups were very similar (High Group 1 Mean 5.92; Low Group 1 Mean 5.36) in this test of ability to draw circles simultaneously with both hands (Table XV, page 99). This suggested that it was not a useful test for distinguishing differences in this sample of children. The selection of only right handed, right eyed children appeared to contribute to the uniformity in the scores. Directionality was one criterion in this test and children of consistent laterality tend to make movements which are more similar in direction than do children who have inconsistent or crossed dominance.

Circle Drawing. Table XV, page 99, indicated that the performances of the two groups on this measure of directionality and motor control were very similar

(High Group 1 Mean 8.12; Low Group 1 Mean 8.28) and did not discriminate between children of good and poor rhythmic ability; the findings suggested that children in grade one had developed the ability to control their movements when drawing simple forms (Table XV, page 99). The implication from these findings was that children who lacked this ability would be severely handicapped in basic visual-motor skills.

Grade Three High and Low Reading Ability Groups

There were significant differences,in several areas of ability, between the high and low reading groups in grade three. Table XVIII presents the means for general abilities and chronological age for the two groups. The superiority of the good readers was indicated in the following areas: Total Rhythmic Ability Score (High Group 3 Mean 72.02; Low Group 3 Mean 64.76), arithmetic ability (High Group 3 Mean 72.08; Low Group 3 Mean 56.44) and school writing ability (High Group 3 Mean 62.60; Low Group 3 Mean 56.28). These findings revealed that the good readers in grade three tended to perform better than the poor readers in other areas of school achievement and in rhythmic ability. The intelligence of the two groups did not differ significantly (High Group 3 Mean 108.52; Low Group 3 Mean 105.44).

The intercorrelations between general abilities

TABLE XVIII

SUMMARY OF MEANS FOR GENERAL ABILITIES AND CHRONOLOGICAL AGE
FOR HIGH AND LOW READING ABILITY GROUPS IN GRADE THREE

Number of pupils--50	High Group--25			Low Group--25			
General Abilities & Chronological Age	High Group 3			Low Group 3			
	Range	Mean	S.D.	Range	Mean	S.D.	"t"
	A	B	C	D	E	F	G
1. C. A. (mo.)	101-114	106.56	3.41	101-115	106.68	3.72	0.12
2. I. Q. Test	96-122	108.52	7.17	89-120	105.44	8.74	1.33
3. Total Rhythmic Ability Score	52.5-83.5	72.02	7.75	53-80	64.76	5.91	3.65**
4. E.P.S.B. Word Test III	26-48	38.28	5.06	14-35	24.24	4.55	10.12**
5. Gates ND Test	19-43	30.20	5.40	8-29	18.04	5.75	7.55**
6. Gates GS Test	9-22	13.84	3.18	5-16	9.36	3.21	4.85**
7. Writing (school test)	57-76	62.60	7.07	44-90	56.28	8.60	2.78**
8. Physical Education (school test)	57-72	66.48	6.69	57-90	62.52	8.10	1.85
9. Arithmetic (school test)	57-90	72.08	11.53	57-72	56.44	10.68	4.87**

* Significant at .05 level of confidence = 2.01
** Significant at .01 level of confidence = 2.69

(including the total rhythmic performance) and chronological age are presented in Table XIX, and Table XX, page 112. According to these results, rhythmic ability continued to show the positive relationship with reading, in both high and low reading groups, which was suggested by the correlations found for the total grade (Table IX, page 79). For Low Group 3, the correlations of .35, .23, and .24--between the three reading tests and rhythmic ability--suggested that there was a higher relationship between these abilities for this group, than for the good readers whose scores obtained correlations of .24, .24, and .02.

Because the two grade three groups differed in reading and rhythmic ability, but were quite similar in intelligence, a comparison of their performances on the rhythmic ability sub-tests was thought to have possible significance for diagnosis of reading difficulties. Table XXI, page 113, indicates the means and standard deviations for High Group 3 and Low Group 3, for the rhythm sub-tests. Of the nine sub-tests, three showed significant differences between the performances of the two groups. The good readers were superior in the following tests: (1) Auditory-Visual Integration, (2) Auditory-Motor Match, and (3) Knox Cube Imitation Test. The sub-tests were examined in the order of their

TABLE XIX

INTERCORRELATIONS BETWEEN GENERAL ABILITIES AND CHRONOLOGICAL AGE FOR HIGH READING ABILITY GROUP, GRADE THREE

N=25 Tests correlated with C.A.	C. A.	I. Q.	Total Rhythmic Ability Score	E.P.S.B. Word Test III	Gates ND Test	Gates GS Test	Printing	Physical Education	Arithmetic
	A	B	C	D	E	F	G	H	I
1. C. A.		-.08	.19	-.29	.17	-.21	.38	-.17	-.20
2. I. Q. Test			.24	.36	.33	.24	.38	.41	.24
3. Total Rhythmic Ability Score				.24	.24	.02	.12	.39	.36
4. E.P.S.B. Word Test III					.15	.44	.14	.18	.18
5. Gates ND Test						.36	.29	.25	.21
6. Gates GS Test							.30	.005	-.06
7. Printing (school test)								.15	-.13
8. Physical Education (school test)									.57
9. Arithmetic (school test)									

Significant at .05 level of confidence —— = .40

Significant at .01 level of confidence —— = .50

TABLE XX

INTERCORRELATIONS BETWEEN GENERAL ABILITIES AND CHRONOLOGICAL AGE FOR LOW READING ABILITY GROUP, GRADE THREE

N=25 Tests correlated with C. A.	C. A.	I. Q.	Total Rhythmic Ability Score	E.P.S.B. Word Test III	Gates ND Test	Gates GS Test	Printing	Physical Education	Arithmetic
	A	B	C	D	E	F	G	H	I
1. C. A.		-.08	-.01	-.25	.02	-.39	-.24	.31	-.17
2. I. Q. Test			.14	-.02	-.18	.10	.32	.20	<u>.40</u>
3. Total Rhythmic Ability Score				.35	.23	.24	.15	.16	.11
4. E.P.S.B. Word Test III					-.36	.02	.14	-.12	.14
5. Gates ND Test						<u>.59</u>	.24	.05	.04
6. Gates GS Test							.37	-.12	.01
7. Printing (school test)								.08	.29
8. Physical Education (school test)									.27
9. Arithmetic (school test)									

Significant at .05 level of confidence —— = .40

Significant at .01 level of confidence —— = .50

TABLE XXI

MEANS FOR RHYTHMIC ABILITY SUB-TESTS FOR HIGH AND LOW READING ABILITY GROUPS IN GRADE THREE

Number of pupils--50	High Group--25			Low Group--25			
Tests	High Group 3			Low Group 3			
	Range	Mean	S.D.	Range	Mean	S.D.	"t"
	A	B	C	D	E	F	G
1. Jumping	4-8	7.04	1.22	4-8	6.28	1.64	1.82
2. Circle Drawing	7-10	9.00	1.02	4-10	8.36	1.32	1.88
3. Double Circle	1-9	6.04	1.99	3-9	6.32	1.85	0.50
4. Rhythmic Writing	8-12	10.36	1.09	7-12	9.80	1.26	1.64
5. Rhythmic Designs	4-7	6.14	0.94	3-7	5.90	1.15	0.79
6. Auditory-Motor Match	8-17	13.84	2.54	8-16	11.72	2.01	3.21**
7. Knox Cube Imitation Test	6-10	7.32	1.26	3-9	6.28	1.64	2.47*
8. Auditory-Visual Integration	3-10	8.28	1.56	4-10	6.64	1.72	3.46**
9. Clapping	1-5	4.04	1.04	2-5	3.56	0.90	1.71

* Significant at .05 level of confidence = 2.01

** Significant at .01 level of confidence = 2.69

importance, which was determined by the size of the difference between the means.

<u>Auditory-Visual Integration</u>. A significant difference, at the one percent level of confidence, existed between the means for this test for good and poor readers (High Group 3 Mean 8.28; Low Group 3 Mean 6.64) with the good readers showing superior ability (Table XXI). Examination of the range (High Group 3 Range 3 - 10; Low Group 3 Range 4 - 10) revealed that the ability to equate auditory and visual stimuli was not synonymous with reading ability. However, the findings suggested that poor readers, who presumably were poor in noting relationships between sounds and words, tended to be deficient in relating very simple auditory and visual stimuli. The intercorrelations for this test with the three grade three reading tests (Table XXII, and Table XXIII, page 116) were inconsistent and generally uninformative.

<u>Auditory-Motor Match</u>. A significant difference at the one percent level of confidence existed between the means for this test for good and poor readers (High Group Mean 13.84; Low Group Mean 11.72) indicating that the good readers were superior in the ability to retain and respond to patterns of sounds (Table XXI). Examination

TABLE XXII

INTERCORRELATIONS BETWEEN RHYTHMIC ABILITY SUB-TESTS, AND BETWEEN SUB-TESTS AND INTELLIGENCE, TOTAL RHYTHMIC ABILITY SCORE, AND READING ACHIEVEMENT TESTS FOR HIGH READING ABILITY GROUP, GRADE THREE

N=25 Tests correlated	Jumping	Circle Drawing	Double Circle	Rhythmic Writing	Rhythmic Designs	Auditory-Motor Match	Knox Cube Test	Auditory-Visual Integration	Clapping
	A	B	C	D	E	F	G	H	I
1. I. Q. Test	.20	.33	-.08	-.04	.26	.12	.26	.24	.23
2. E.P.S.B. Word Test III	.16	.13	-.12	.05	.02	.28	.07	.32	.38
3. Gates ND Test	-.001	.15	.12	.22	.12	.28	.17	.07	.03
4. Gates GS Test	.04	.28	-.14	-.12	.07	.03	.20	.03	-.23
5. Total Rhythmic Ability Score	.58	.53	.62	.68	.09	.81	.43	.69	.70
6. Jumping		.23	.25	.44	-.02	.34	.10	.33	.51
7. Circle Drawing			.26	.34	.10	.22	.16	.40	.41
8. Double Circle				.20	-.25	.42	.03	.48	.39
9. Rhythmic Writing					.01	.54	.31	.27	.60
10. Rhythmic Designs						.04	.20	-.11	-.07
11. Auditory-Motor Match							.32	.49	.46
12. Knox Cube Imitation Test								.16	.14
13. Auditory-Visual Integration									.41
14. Clapping									

Significant at .05 level of confidence ——— = .40

Significant at .01 level of confidence ——— = .50

TABLE XXIII

INTERCORRELATIONS BETWEEN RHYTHMIC ABILITY SUB-TESTS, AND BETWEEN SUB-TESTS AND INTELLIGENCE, TOTAL RHYTHMIC ABILITY SCORE, AND READING ACHIEVEMENT TESTS FOR LOW READING ABILITY GROUP, GRADE THREE

N=25 Tests correlated	Jumping A	Circle Drawing B	Double Circle C	Rhythmic Writing D	Rhythmic Designs E	Auditory-Motor Match F	Knox Cube Test G	Auditory-Visual Integration H	Clapping I
1. I. Q. Test	-.17	-.01	.16	-.001	.29	.23	-.06	-.05	.24
2. E.P.S.B. Word Test III	.19	.09	.17	.16	.29	.33	-.14	.11	.22
3. Gates ND Test	-.01	-.06	.22	.35	.29	-.05	.28	-.04	-.10
4. Gates GS Test	-.24	.06	.28	.12	.44	.18	.11	.002	-.11
5. Total Rhythmic Ability Score	.27	.35	.32	.53	.46	.78	.19	.41	.67
6. Jumping		.03	-.06	.41	.21	.05	-.27	-.30	.27
7. Circle Drawing			.15	.20	-.13	.16	-.12	.07	.03
8. Double Circle				.03	.04	.19	-.13	-.15	.08
9. Rhythmic Writing					.23	.18	.02	-.04	.40
10. Rhythmic Designs						.31	.06	.14	.09
11. Auditory-Motor Match							-.05	.51	.64
12. Knox Cube Imitation Test								.02	.14
13. Auditory-Visual Integration									.21
14. Clapping									

Significant at .05 level of confidence —— = .40

Significant at .01 level of confidence —— = .50

of the intercorrelations, presented in Table XXII, page 115, and Table XXIII, suggested there was a relationship between reading and auditory-motor ability in both reading groups. This finding emphasized the importance of the relationship between auditory perception of patterns and success in reading.

Knox Cube Imitation Test. Table XXI, page 113, showed that a significant difference, at the five percent level of confidence, existed between the means for High Group 3 and Low Group 3 for this test (High Group 3 Mean 7.32; Low Group 3 Mean 6.28), with the high reading group showing superiority over the low reading group. The intercorrelations, between the scores in this test and the reading tests (Table XXII, page 115, and Table XXIII), suggested a positive, though not consistent, relationship between the abilities examined. The nature of the relationship between a performance test of ability to remember a sequence of movements and reading ability was not clear, but was thought to be related to attention span and awareness of sequence.

Circle Drawing. Table XXI, page 113, revealed that there was not a significant difference between the means for this test for good and poor readers in grade three (High Group 3 Mean 9.00; Low Group 3 Mean 8.36).

The conclusions reached regarding test performances were the same as for the total grade three performances (page 72) and for high and low reading groups in grade one (pages107 and 108).

Jumping. Table XXI, page 113, indicated that that there was no significant difference between the means for good and poor readers for this test (High Group 3 Mean 7.04; Low Group 3 Mean 6.28). However, because both groups tended to perform in a similar manner, a poor performance in this test would suggest the need for planning remedial training in motor skills (Kephart, 1960).

Clapping. Table XXI, page 113, indicated that there was no significant difference between the means for this test for good and poor readers in grade three (High Group 3 Mean 4.04; Low Group 3 Mean 3.56) although the good readers tended to be better than the poor readers. These results indicated that, whereas the test might be related to rhythmic ability (as defined in this study), the test, in its present form was not a useful measure of differences in grade three, but might serve to identify severe deficiencies in this ability.

Rhythmic Writing. Table XXI, page 113, indicated that there was no significant difference between the

means for this test for good and poor readers (High Group 3 Mean 10.36; Low Group 3 Mean 9.80). The good readers showed only slightly better ability to reproduce visual patterns by rhythmic movements. Training and practice appeared to have contributed to the fairly uniform performances by the two groups. These results suggested that a weakness in this ability, at the grade three level, would present a handicap which might need special remedial procedures to alleviate. For the total grade, the intercorrelations between the total rhythmic ability score and school writing (Table IX, page 79) had shown a significant relationship, at the five percent level of confidence ($r = .28$), which suggested that the ability examined in Rhythmic Writing had an association with school writing.

Rhythmic Designs. Table XXI, page 113, showed that there was no significant difference between the means for this test for good and poor readers (High Grade 3 Mean 6.14; Low Group 3 Mean 5.90), indicating that either the children had similar ability in this area or that the test was not difficult enough to distinguish between levels of ability in children of this age.

Double Circle Test. Table XXI, page 113, showed that there was a very slight difference in favor of the poor readers between the means for this test (High Group 3

Mean 6.04; Low Group 3 Mean 6.32). These results confirm the finding, which has been indicated previously, that right-handed children in grade three, of good and poor reading ability, do not differ significantly in tests involving simple forms and directionality.

COMPARISON OF RHYTHMIC ABILITY IN READING ABILITY GROUPS BETWEEN THE GRADES

Significant differences had been found between grade one and grade three children in their total rhythmic ability scores and in eight of the nine rhythmic sub-tests. Comparison between the reading groups was necessary to determine whether these differences were as great between good readers at the two grade levels, and between poor readers in these grades, as they were for the total grades.

High Group 1 and High Group 3

There were no children in High Group 1 who had spent more than one year in school, and no children in High Group 3 who had spent more than three years or less than two years eight months in school. The children in High Group 3 were approximately two years older than those in High Group 1 (High Group 1, C.A. Mean 83.80; High Group 3, C.A. Mean 106.56) as shown in Table II, page 43. Table XXIV permits a comparison to be made of differences between the means for rhythm tests and intelligence for

TABLE XXIV

SUMMARY OF DIFFERENCES BETWEEN MEANS FOR RHYTHMIC ABILITY TESTS AND INTELLIGENCE TESTS FOR HIGH READING ABILITY GROUPS, GRADES ONE AND THREE, AND LOW READING ABILITY GROUPS, GRADES ONE AND THREE

		Number of pupils in High Groups=50					Number of pupils in Low Groups=50				
		High Group 1		High Group 3			Low Group 1		Low Group 3		
	Tests	Mean	S.D.	Mean	S.D.		Mean	S.D.	Mean	S.D.	"t"
		A	B	C	D	E	F	G	H	I	J
1.	Jumping	5.92	1.65	7.04	1.22	2.68*	4.64	1.79	6.28	1.64	3.32**
2.	Circle	8.12	0.77	9.00	1.02	3.38**	8.28	1.34	8.36	1.32	0.21
3.	Double Circle	5.92	2.13	6.04	1.99	0.20	5.36	2.08	6.32	1.85	1.69
4.	Rhythmic Writing	7.38	2.12	10.36	1.09	6.13**	5.34	1.48	9.80	1.26	11.22**
5.	Rhythmic Designs	5.56	1.29	6.14	0.94	1.78	4.00	1.24	5.90	1.15	5.50**
6.	Auditory-Motor Match	11.52	2.74	13.84	2.54	3.04**	8.40	2.58	11.72	2.01	4.98**
7.	Knox Cube Imitation Test	6.00	1.20	7.32	1.26	3.72**	5.32	1.52	6.28	1.64	2.11*
8.	Auditory-Visual Integration	6.80	1.47	8.28	1.56	3.38**	4.36	1.44	6.64	1.72	4.98**
9.	Clapping	3.44	1.20	4.04	1.04	1.85	2.60	1.55	3.56	0.90	2.63*
10.	Total Rhythmic Ability Score	60.76	8.53	72.02	7.75	4.78**	47.72	6.26	64.76	5.91	9.69**
11.	I. Q. Test	110.32	7.37	108.52	7.17	0.86	97.92	8.59	105.44	8.74	3.01**

* Significant at .05 level of confidence = 2.01

** Significant at .01 level of confidence = 2.69

reading groups from each grade. According to this information, although the good readers from grades one and three were similar in intelligence (High Group 1, I.Q. Mean 110.32; High Group 3, I.Q.Mean 108.52), a difference at the one percent level of confidence existed between their rhythmic ability, as measured by the Total Rhythmic Ability Score (High Group 1 Mean 60.76; High Group 3 Mean 72.02). The implication from this finding was that rhythmic ability showed improvement from grade one to grade three in children of high ability.

In order to clarify the nature of the growth in rhythmic ability in good readers, the differences between the means for the two groups for the rhythmic ability sub-tests were assessed. Table XXIV indicated that, of the nine sub-tests of rhythmic ability, five tests showed significant differences (at the one percent level of confidence) between the means for High Group 1 and High Group 3; the comparison of total Grades (Table VI, page 66) had revealed differences in seven of the nine tests. The good readers in grade three were superior to the good readers in grade one in the abilities measured by the following tests:

1. Rhythmic Writing
2. Knox Cube Imitation Test
3. Auditory-Visual Integration
4. Circle Drawing
5. Auditory-Motor Match

A difference, at the five percent level of confidence, existed between performances in the test Jumping, with High Group 3 showing greater ability.

These results clearly indicated that good readers in grade three could be expected to have higher ability than good readers in grade one in tests of visual-motor, auditory-visual, and auditory-motor rhythmic abilities, and in measures of fine and gross muscle co-ordination. The smaller differences, noted in the tests Clapping, Rhythmic Designs, and Double Circle Test, suggested that these tests were not sufficiently difficult to discriminate between the groups, or that the abilities being examined had been acquired by the time a child had spent a year in grade one.

Low Group 1 and Low Group 3

The children in Low Group 1 and Low Group 3 had had the same amount of schooling as the children in High Group 1 and High Group 3, and, as indicated in Table II, page 43, there was approximately the same difference in age (Low Group 1, C.A. Mean 83.24; Low Group 3, C.A. Mean 106.68). Table XXIV, page 121, showed that a significant difference at the one percent level of confidence existed between the means for intelligence tests for the two groups (Low Group 1, I.Q. 97.92; Low Group 3, I.Q. Mean 105.44), indicating that the children

in the grade three low reading ability group were superior to the grade one low reading group in intelligence. A highly significant difference existed between the means for Low Group 1 and Low Group 3 for total rhythmic ability also. This difference($t = 9.69$) was considerably greater than that shown between the high reading ability groups ($t = 4.78$). The higher intelligence of Low Group 3 over Low Group 1 may have been a contributing factor to the greater spread between the means for rhythmic ability. However, on the basis of the results which were obtained, it seemed probable that children in the low reading ability group in grade one could be expected to show development, from grade one to grade three, in the rhythmic abilities which were examined in this study.

The differences which were observed between the test performance of Low Group 1 and Low Group 3 were recorded in Table XXIV, page 121. The poor readers in grade 3 showed greater ability than the poor readers in grade one in all rhythm tests. Table XXIV, page 121, indicated that, of the nine sub-tests of rhythmic ability, significant differences at the one percent level of confidence were obtained for performances on five sub-tests:

1. Rhythmic Writing
2. Rhythmic Designs
3. Auditory-Motor Match
4. Auditory-Visual Integration
5. Jumping

Two sub-tests, Clapping and Knox Cube Imitation Test, showed differences at the five percent level of confidence, indicating that the superiority of Low Group 3 over Low Group 1 was evident but not as marked in these abilities. The differences between the means for performances on the two remaining tests, Circle Drawing and Double Circle Test, were low or negligible, suggesting that the groups did not differ greatly in these abilities. In summary, these results indicated that there were decided differences between the ability of Low Group 1 and Low Group 3 in five of the abilities examined, and to a lesser degree in two additional areas, with the older children showing superiority in all instances.

High Group 1 and Low Group 3

Poor readers in grade three were significantly poorer in rhythmic ability than good readers in grade three (Table XVIII, page 109), but were significantly better than poor readers in grade one (Table XXIV, page 121). A comparison was made between Low Group 3 and High Group 1, in order to assess the level of development which the poor readers in grade three had reached in relation to successful readers at the grade one level. Table XXV gives a summary of the differences between the means for High Group 1 and Low Group 3.

TABLE XXV

SUMMARY OF DIFFERENCES BETWEEN MEANS FOR RHYTHMIC ABILITY TESTS AND INTELLIGENCE TESTS FOR HIGH READING ABILITY GROUP, GRADE ONE, AND LOW READING ABILITY GROUP, GRADE THREE

	Number of Pupils--50		High Group 1--25				Low Group 3--25	
	Tests	High Group 1			Low Group 3			
		Range	Mean	S.D.	Range	Mean	S.D.	"t"
		A	B	C	D	E	F	G
1.	Jumping	2-8	5.92	1.65	4-8	6.28	1.64	.76
2.	Circle Drawing	6-9	8.12	0.77	4-10	8.36	1.32	.77
3.	Double Circle	1-9	5.92	2.13	3-9	6.32	1.85	.69
4.	Rhythmic Writing	3.5-10.5	7.38	2.12	7-12	9.80	1.26	4.81**
5.	Rhythmic Designs	2.5-7.0	5.56	1.29	3-7	5.90	1.15	.96
6.	Auditory-Motor Match	8-17	11.52	2.74	8-16	11.72	2.01	.29
7.	Knox Cube Imitation Test	4-9	6.00	1.20	3-9	6.28	1.64	.68
8.	Auditory-Visual Integration	4-9	6.80	1.47	4-10	6.64	1.72	.35
9.	Clapping	1-5	3.44	1.20	2-5	3.56	0.90	.39
10.	Total Rhythmic Ability Score	44.5-77.5	60.76	8.53	53-80	64.76	5.91	1.89
11.	I. Q. Test	94-124	110.32	7.37	89-120	105.44	8.74	2.09*

* Significant at .05 level of confidence = 2.01

** Significant at .01 level of confidence = 2.69

There were no children in High Group 1 who had spent longer than one year in school, and no children in Low Group 3 who had spent less than two years eight months in school or more than three years. The difference in the means for chronological age for the two groups was 23 months (High Group 1, C.A. 83.80, S.D. 3.53; Low Group 3, C.A. 106.68, S.D. 3.72, as shown in Table XII, page 93, and Table XVIII, page 109). Examination of Table XXV revealed that there was a significant difference, at the one percent level of confidence, between the means for intelligence for the two groups, with the grade one children having higher ability. However, the means for intelligence for both groups were above the national and local norms (High Group 1, I.Q. Mean 110.32, S.D. 7.37; Low Group 3, I.Q. Mean 105.44, S.D. 8.74).

There was no significant difference between the means for rhythmic ability for the two groups, although the grade three children tended to have slightly better rhythmic ability (High Group 1 Mean 60.76; Low Group 3 Mean 64.76). A highly significant difference, at the one percent level of confidence (shown in Table XXV), existed between the means for only one of the sub-tests, <u>Rhythmic Writing</u> (High Group 1 Mean 7.38; Low Group 3 Mean 9.80), in favor of the older children. Low Group 3 showed a slight superiority over High Group 1 in all

tests except Auditory-Visual Integration, in which grade one children performed slightly better than grade three children (High Group 1, A-V Mean 6.80; Low Group 3, A-V Mean 6.64). Differences between the two groups, except in Rhythmic Writing, were therefore negligible. The superiority of Low Group 3 in Rhythmic Writing was attributed, in part at least, to the practice and instruction the older children had received in cursive writing. The lack of a significant difference between the two groups in jumping ability was rather surprising. Because jumping tends to be an age and sex linked skill in young children, it had been expected that the grade three group would excel--partly because of their age, and partly because there were more girls in this group (High Group 1, 13 boys : 12 girls; Low Group 3, 10 boys : 15 girls). Groups had not been composed of equal numbers of boys and girls due to factors beyond the control of the investigator. The lack of a significant difference in the performances attested to the general level of competence, in measures of balance, shown by the good readers in grade one.

It was apparent that, if rhythmic ability contributed to the overall efficiency of a child's performance, poor readers in grade three, despite two additional years of schooling, had only now reached the

level of ability which was already displayed by good readers in grade one (with the exception of the visual-motor abilities examined in rhythmic writing). Furthermore, if these abilities were more important in the early stages of learning to read, Low Group 3 was presumably handicapped in grade one by having a much lower level of rhythmic ability at that time.

SEX DIFFERENCES IN RHYTHMIC ABILITY

In order to examine the possibility that there were sex differences in rhythmic ability, the significance of the differences between the means for performances in all rhythmic ability tests, by the boys and girls in the total grades and in the reading ability groups within each grade, was determined.

Although there was an equal number of boys and girls in each grade sample, the composition of the reading ability groups varied, due to the exclusion of children who had not received one of the two intelligence tests accepted in this study. In grade one, the high reading ability group consisted of thirteen boys and twelve girls and the low group had twelve boys and thirteen girls; in grade three, the high reading ability group had fifteen boys and ten girls, and the low group, ten boys and

fifteen girls (Table III, page 45). Because of the small number of boys and girls in each group, the results obtained from comparisons should be interpreted with caution.

Table XXVI presents the only significant differences which were found to exist between boys and girls in grade one and grade three; Table XXVII, page 132, and Table XXVIII, page 133, indicate the only significant differences which were found to exist between the boys and girls within each reading ability group. However, in cases where there was a difference at one level but not at another, results were included for both groups for the purpose of comparison.

Total Grades

Table XXVI shows the only significant difference in rhythmic ability between boys and girls in both grades was in the test Jumping. In this test, grade one girls showed a degree of superiority at the one percent level of confidence over the grade one boys (Grade 1 Boys Mean 4.48; Grade 1 Girls Mean 6.08). This difference was confirmed to the same extent in the performance by boys and girls in grade three (Grade 3 Boys Mean 6.00; Grade 3 Girls Mean 7.32). Girls in grades one and three

TABLE XXVI

SUMMARY OF SIGNIFICANT SEX DIFFERENCES IN RHYTHMIC ABILITY IN GRADE ONE AND GRADE THREE

Number of pupils in Grade One--50 Boys--25 Girls--25
Number of pupils in Grade Three--50 Boys--25 Girls--25

Tests	Boys			Girls			"t"
	Range	Mean	S.D.	Range	Mean	S.D.	
	A	B	C	D	E	F	G
Total Grade 1							
Jumping	2-8	4.48	1.47	2-8	6.08	1.81	3.36 G**
Knox Cube Imitation Test	4-9	6.16	1.08	1-7	5.16	1.51	2.63 B*
Total Grade 3							
Jumping	4-8	6.00	1.41	4-8	7.32	1.26	3.42 G**
Knox Cube Imitation Test	4-8	7.00	0.98	3-10	6.60	1.94	0.90

* Significant at .05 level of confidence = 2.01

** Significant at .01 level of confidence = 2.69

TABLE XXVII

SUMMARY OF SIGNIFICANT SEX DIFFERENCES IN RHYTHMIC ABILITY IN HIGH AND LOW READING GROUPS, GRADE ONE

Number of pupils in High Group 1--25 Boys--13 Girls--12

Number of pupils in Low Group 1--25 Boys--12 Girls--13

Tests	Boys			Girls			"t"
	Range	Mean	S.D.	Range	Mean	S.D.	
	A	B	C	D	E	F	G
High Group 1							
Jumping	2-8	5.15	1.56	5-8	6.75	1.30	2.65 G*
Knox Cube Imitation Test	5-9	6.54	1.08	4-8	5.42	1.04	2.53 B*
Rhythmic Designs	2.5-7.0	5.42	1.36	3-7	5.11	1.20	0.53
Low Group 1							
Jumping	2-5	3.75	0.92	2-8	5.46	1.99	2.61 G*
Knox Cube Imitation Test	5-7	5.75	0.92	2-8	4.92	1.82	1.36
Rhythmic Designs	3-6	4.54	1.11	2-5	3.50	1.14	2.21 B*

* Significant at .05 level of confidence = 2.07

** Significant at .01 level of confidence = 2.81

TABLE XXVIII

SUMMARY OF SIGNIFICANT SEX DIFFERENCES IN RHYTHMIC ABILITY IN HIGH AND LOW READING GROUPS, GRADE THREE

Number of pupils in High Group 3--25 Boys--15 Girls--10
Number of pupils in Low Group 3--25 Boys--10 Girls--15

Tests	Boys			Girls			"t"
	Range	Mean	S.D.	Range	Mean	S.D.	
	A	B	C	D	E	F	G
High Group 3							
Jumping	4-8	6.60	1.31	6-8	7.70	0.64	2.37 G*
Knox Cube Imitation Test	6-9	7.07	1.06	6-10	7.70	1.42	1.22
Circle Drawing	7-11	8.87	1.09	8-10	9.20	0.87	0.78
Low Group 3							
Jumping	4-7	5.10	1.04	4-8	7.07	1.48	3.49 G**
Knox Cube Imitation Test	6-9	6.90	0.83	3-9	5.87	1.89	1.56
Circle Drawing	6-10	7.70	1.73	8-10	8.80	0.65	2.14 G*

* Significant at .05 level of confidence. Critical ratio = 2.07

** Significant at .01 level of confidence. Critical ratio = 2.81

were better than the boys in these grades in the tasks of jumping, skipping, and rhythmic hopping--which served as measures of balance and of the ability to perform integrated movements. The findings in this study were in agreement with Jenkins (cited by Cron, 1957) who found that girls of five, six, and seven years were superior to boys of these ages in tests requiring a sense of balance. Boys in grade one performed more ably than girls on the *Knox Cube Imitation Test*--a test of ability to remember a sequence of movements; however, this degree of superiority was not maintained in grade three, although the boys' performances were more consistent than the girls (Table XXVI, page 131).

Grade One High and Low Reading Ability Groups

In both the high and low reading groups grade one girls were more skilled than boys in the jumping tasks (Table XXVII, page 132). In the high reading group, boys were superior to girls in the test of memory for a sequence of movements (*Knox Cube Imitation Test*); however, this superiority was not as evident in the low reading ability group. Boys in the low reading group were better in organizing spatial designs than were the girls (*Rhythmic Designs*).

Grade Three High and Low Reading Ability Groups

The girls in both reading groups in grade three continued to show their superiority over the boys in jumping. This advantage was greater in the low reading group in grade three than for any other group in either grade. Girls in the low group showed better motor control in circle drawing (Table XXVIII, page 133).

Summary of Sex Differences

In summary, there was strong evidence that, of the rhythmic abilities measured in this study, tests of jumping ability revealed the only major sex-linked difference at both grade levels. There was a tendency for boys in grade one to perform better than girls in tasks which demanded spatial judgments.

SUMMARY OF FINDINGS

The analysis of data began with a comparison of the performances of grade one and grade three children, which determined that there were significant differences between the grades in rhythmic ability. An assessment of the intercorrelations, obtained for rhythmic ability and school achievement test scores, supported the more detailed examination of the rhythm sub-tests in relation to reading achievement. The assessment was carried out first through an examination of individual grades, and

then in a comparison between total grades.

The investigation next compared the rhythmic performances of good and poor readers within each grade by examining the means, standard deviations, and intercorrelations for pertinent tests. This was followed by a comparison of the rhythmic performances of the good readers in grades one and three, and of the poor readers in these grades. Having established that growth in rhythmic ability could be expected in children of both good and poor reading achievement, a comparison was made between the good readers in grade one and the poor readers in grade three, in order to clarify the level of development which had been reached by the older children. The analysis of data concluded with a brief comparison of sex differences in rhythmic ability.

The comparison of the performances of grade one and grade three children, in tests of rhythmic ability and intelligence, produced the following results:

1. The performances of the grade three children on the total rhythmic ability test battery were significantly superior to those of the grade one children.
2. The grade three children showed significantly greater ability than the grade one children on eight of the nine sub-tests in the rhythmic

ability battery.

3. The overlapping of scores on all tests, between the grades, indicated that a wide range of rhythmic ability was present in each grade.
4. The level of intelligence, indicated by the means for each grade, was similar for each grade.

To examine the possibility that an association existed between rhythmic ability and reading achievement, and to determine whether rhythmic ability was more closely related to reading ability than to other abilities (intelligence, arithmetic, printing or writing, and physical education), the relationships between measures of achievement in these areas were examined within each grade. The relationships of the rhythmic ability sub-test scores with reading tests and the Total Rhythmic Ability Score were also assessed. The following conclusions were reached concerning the sample of grade one children in this study:

1. Rhythmic ability tests were significantly related to intelligence and ability in reading, arithmetic and printing, with the closest relationship occurring between rhythmic ability and reading.
2. All of the abilities named showed a positive association with each other.
3. Of the rhythmic ability sub-tests, certain tests

of auditory-visual, auditory-motor, and visual-motor ability had higher relationships with both reading and general rhythmic ability scores than did the remaining tests.

The following conclusions were reached concerning the sample of grade three children in this study:

1. Rhythmic ability tests were most closely associated with measures of reading and arithmetic ability, but had positive associations with physical education and school writing.
2. Rhythmic ability had a positive but not significant relationship with intelligence.
3. Of the rhythmic sub-tests used in this study, tests involving auditory perception were most effective in measuring rhythmic ability and had the most significant relationship with reading tests.

A comparison of the relationships between rhythmic ability and school achievement test scores for grade one and grade three children produced these conclusions:

1. Rhythmic ability in both grades had a closer relationship with reading and arithmetic achievement than with other school achievement or with intelligence scores.
2. Rhythmic ability appeared to be more closely

related to reading achievement in grade one than in grade three.

3. In grade one, six rhythmic ability sub-tests had significant associations with reading test scores, but in grade three only three sub-tests showed consistent positive associations with reading scores.
4. Tests involving auditory perception and/or auditory memory had the highest relationships with reading ability in both grades.

To determine whether differences existed in rhythmic ability between the high and low reading groups within the grades, and whether the relationships observed between general abilities, and rhythmic sub-tests and reading tests, were similar to those found in the total grades, the performances of each reading ability group, in each grade, were examined. The smaller numbers of children involved in the group comparisons, and the narrow range of difficulty presented by some of the tests were considered to reduce the significance of the findings. The comparison of the high and low reading groups in grade one resulted in the findings which follow:

1. Good readers in grade one tended to score higher than poor readers on the total rhythmic ability test battery, although their performances showed a wider range of ability than did the performances

of the poor readers.

2. The Total Rhythmic Ability Score was not related to the reading test scores in the high ability group, but a positive and consistent relationship was observed between rhythmic ability and reading tests for the low reading ability group.

3. The good readers performed significantly better than the poor readers on six of the nine rhythm sub-tests:

   a) Auditory-Visual Integration
   b) Rhythmic Designs
   c) Auditory-Motor Match
   d) Rhythmic Writing
   e) Jumping
   f) Clapping

4. For the good readers in grade one, the relationships between all of the sub-tests and reading were negligible, with the exception of Auditory-Motor Match which had a positive tendency to relate with the reading test scores.

5. For the poor readers, there were positive relationships observed between reading tests and the sub-tests Clapping, Jumping, and Auditory-Motor Match. In addition, scores for the test Auditory-Visual Integration tended to correlate with tests of reading achievement.

The following findings were made concerning the performances of the good and poor readers in grade three on tests

involving rhythm, and concerning the relationship of these tests to reading achievement tests.

1. Good readers tended to perform better than poor readers on the total rhythmic ability test battery, although their performances showed more variation than those of the poor readers.
2. General rhythmic ability showed positive relationships with measures of reading achievement for both high and low reading ability groups, with higher and more consistent associations being obtained for the poor readers.
3. The good readers performed significantly better than the poor readers on three of the nine rhythm sub-tests:

   a) Auditory-Visual Integration
   b) Auditory-Motor Match
   c) Knox Cube Imitation Test

   Their ability in five of the remaining six tests was greater than that of the poor readers but did not reach a level of significance.
4. For the good readers in grade three, all of the rhythmic sub-tests showed an inconsistent pattern of relationships with the reading tests, although tests of auditory perception, Knox Cube Imitation Test, and Circle Drawing gave some evidence of a positive association with reading ability.

5. For the poor readers in grade three, the relationships between tests of rhythmic ability and reading were higher and more consistent for the visual motor tests--Rhythmic Writing, Rhythmic Designs, and Double Circle--than for any of the other tests.

An examination of the differences between the performances on rhythmic ability tests of the following groups: (1) good readers in grades one and three, (2) poor readers in grades one and three, and (3) good readers in grade one and poor readers in grade three, led to the following conclusions:

1. Children in the high reading ability group, at the grade one level, could be expected to show improvement in rhythmic ability from grade one to grade three. The gains made by the grade three children, in this study, were noted in tests of visual-motor skills, of auditory perception and/or span of auditory memory, of memory for sequences of movements, and in measures of balance--with the greatest gains being made in visual-motor skills.
2. Children in the low reading ability group, at the grade one level, could be expected to show considerable improvement in rhythmic ability from grade one to grade three, particularly in visual-

motor skills, auditory perception and auditory memory span, and in measures of balance and integrated movements.

3. Because children in the high reading ability group in grade one differed so slightly from children in the low reading ability group in grade three, except in some visual-motor skills, and because improvement was noted in low reading ability children from grade one to grade three, it was inferred that the poor readers in grade three would have been markedly inferior in rhythmic ability in grade one.

An examination of the performances of boys and girls in grades one and three, to determine whether there were sex differences in rhythmic ability, led to these conclusions:

1. The only significant difference in rhythmic ability between the boys and girls in grade one and in grade three was in jumping ability.
2. There was a tendency for boys in all groups except the high reading ability group in grade three, to be superior to girls in the ability to recall and reproduce a series of movements in space (Knox Cube Imitation Test).
3. There was a tendency in the low reading ability

groups only, for the boys to be superior to the girls in the ability to copy rhythmic patterns and to align them spatially; this difference reached a level of significance in grade one.

CHAPTER V

FINDINGS AND CONCLUSIONS

This study has attempted to determine the levels of rhythmic ability--defined as the ability to reproduce or match patterns of sounds, forms, or movements--of children in grades one and three, and to investigate the possible relationship of rhythmic ability to reading achievement. A comparison was made of the rhythmic ability of fifty children in grade one and fifty children in grade three, selected on the basis of reading achievement and right lateral dominance, and grouped according to grade, reading ability, and sex. The relationships between rhythmic ability tests and tests of reading achievement were assessed for the total grades, for reading groups within and between the grades, and for boys and girls in each grade.

This chapter will present the conclusions which have been drawn from these comparisons. Implications for general reading instruction and for diagnosis of reading difficulties are discussed. Limitations of the findings of the study are assessed and suggestions for further research are presented.

SUMMARY OF CONCLUSIONS

Hypothesis One

There is no significant difference in the rhythmic ability of grade one children and the rhythmic ability of grade three children.

All children in the sample were given a battery of nine tests of rhythmic ability in which sounds, shapes, or movements had to be organized according to given patterns. A highly significant difference was found between the means for the *Total Rhythmic Ability Battery*, indicating that the grade three children were superior to the grade one children in general rhythmic ability. Of the nine sub-tests in the rhythm battery, significant differences were found to exist between the means for eight of these tests, in favor of the grade three children. On the basis of this evidence Hypothesis One is rejected.

The comparison of the performances on tests of rhythmic ability, of children in grade one and children in grade three, resulted in the following conclusions:

1. Grade three children showed improvement over grade one children in the ability to recognize, retain, and reproduce visual, auditory, and motor patterns.
2. The overlapping in the range of scores for all rhythmic tests indicated that there were children in each grade who were considerably superior to, or weaker than, their classmates in the abilities

which were being examined.

3. The visual-motor abilities which were measured in the test of rhythmic writing patterns showed the greatest difference between grades. These abilities appeared to be capable of considerable development during the two years of school experience and age which separated these two grades.
4. The smaller, though significant, difference between the performances on the visual-motor test of ability to space rhythmic patterns (Rhythmic Designs) may have been due partly to the lack of difficulty of the test. The superiority of the older children was indicated, but some children in grade one could perform the task with ease.
5. The similarity of the means for the visual-motor tasks of drawing circles and double circles indicated that, whereas the grade three children were slightly superior in motor control, most children in both grades had acquired the ability to perform adequately. The younger children performed more spontaneously; the older children seemed to rely more on vision and/or reasoning to guide their movements. These tests did not seem to be useful measures of differences between large samples of right-handed, right-eyed children; however, the

findings would support the use of the tests as part of diagnostic procedures for evaluating individual performances.

6. The two tests which involved auditory perception discriminated equally well between the performances of children in grade one and grade three. The memory or attention span of the older children was greater than that of the younger children. Studies of immediate memory for unrelated material show that the average adult can remember 7-9 pieces of unrelated material, but that grouping of stimuli aids recall and results in a longer memory span. The series of sounds which were used in this study had a pattern imposed upon them, and it was assumed that recognition of the pattern would aid recall. Therefore, as the older children tended to do better, it appeared that they were more aware of the patterning of the sounds. Because the means for the two auditory tests showed similar differences between both grades, the inference was made that the ability to respond to auditory stimuli--by tapping or equating visual patterns--may depend largely on the ability to remember the auditory stimuli. The abilities examined in these tests seemed to have less potential for improvement, or

to have had less training, than the visual-motor ability examined in the rhythmic writing test.

7. The tests of motor ability measured: (1) the degree to which large muscle movements were integrated, as in jumping and clapping movements, and (2) the ability to remember regular and irregular series of movements, using finer hand and arm movements. The cues for these tests were not as specific as for the other tests in the battery: in jumping, they were provided by verbal directions and demonstrations; in the other motor tests, they were provided by demonstrations which involved auditory, visual, and motor cues. The grade three children had matured in the abilities which were examined, however the gains made were not as great as in the visual-motor, auditory-motor, and auditory-visual areas of development. The narrower range of difficulty presented by two of the motor tests (Jumping and Clapping), with some children in both grades achieving perfect scores, may have affected these findings.

Hypothesis Two

There is no significant difference in rhythmic ability between the following groups of children:

a) a high reading ability group and a low reading ability group at the grade one level;

b) a high reading ability group and a low reading ability group at the grade three level;
c) a high reading ability group in grade one and a high reading ability group in grade three;
d) a low reading ability group in grade one and a low reading ability group in grade three;
e) a high reading ability group in grade one and a low reading ability group in grade three.

a) Grade one high and low group. A highly significant difference was found between the means for the Total Rhythmic Ability Battery for the two groups. The performances of the high reading ability group were superior to those of the low reading ability group. Of the nine rhythmic sub-tests, significant differences were found between the means for six of these tests, with the high reading ability group showing superiority in each test. On the basis of this evidence Hypothesis Two a) is rejected.

From the significant differences between the means for rhythmic ability tests, for high and low reading ability groups in grade one, the following conclusions were drawn:

1. The children of high reading achievement were more capable than the children of low reading achievement in making appropriate responses to patterned stimuli--termed "rhythmic ability" in this study.
2. Of the nine tests of rhythmic ability, the tests which demanded responses to auditory patterns were

most effective in discriminating between good and poor readers in grade one. The ability to equate auditory and visual stimuli showed the most significant difference between the two groups. In this test, the stimulus was a pattern of sounds and the response demanded that the child recognize the significance of the spaced dot patterns and relate the pattern of sounds to it. Good readers were superior in this ability, and were also more capable when asked to reproduce patterns of sounds by tapping their responses.

3. Tests of visual-motor abilities which involved rhythmic patterns were less effective than the auditory-visual test in discriminating between the two groups, but the results revealed that good readers tended to be better in visual-motor skills also. The good readers were superior to the poor readers, in grade one, in recognizing the significance of the spatial relationships that were involved in the material to be copied and in patterning their movements accordingly.

4. Tests of jumping skill and of memory for movement (Knox Cube Imitation Test) were less effective than tests of auditory-visual, auditory-motor, and visual-motor rhythmic ability in discriminating

between the two groups of readers in grade one. However, there was evidence that the good readers do better than the poor readers on tests which examine both gross and fine muscle co-ordination.

b) Grade three high and low group. There was a significant difference between the means for the Total Rhythmic Ability Battery and for three of the rhythm sub-tests, which indicated that, in grade three, the good readers were superior to the poor readers in rhythmic ability. On no test in the rhythm battery did the poor readers perform better than the good readers, although for some abilities the differences were slight. On the basis of this evidence Hypothesis Two b) is rejected.

The conclusions reached, following a comparison of the performances of children of high and low reading ability in grade three, were:

1. There were fewer significant differences between rhythmic ability between the high and low reading groups in grade three, than between the grade one reading groups. This suggested that differences in rhythmic ability tended to disappear with age and experience. However, it was possible that there were limitations in the tests, and in the methods of evaluating the performances, which affected these findings. In addition, the means for

intelligence differed significantly in favor of the high reading ability groups in grade one, whereas in grade three the groups were both of higher than average intelligence. The areas in which the grade three reading ability groups differed, therefore, may have particular significance for identifying abilities important to reading.

2. The greatest differences between the grade three groups were in tests which involved the auditory perception of tapped patterns, in which the good readers were superior. The test of ability to match a sound pattern with a visual dot pattern showed a slightly greater difference between groups than the test requiring a tapped response. The significance for reading of the ability to perceive and respond to sounds organized in the dimension of time, which was noted in grade one, continued to be of major importance at the grade three level.

3. Good readers were more capable than poor readers in remembering and reproducing a sequence of movements (<u>Knox Cube Imitation Test</u>). The length of attention span may have been a discriminating factor between the two groups. However, the ability to reproduce a series of movements in a

definite sequence appeared deficient in the poor readers in grade three. This group also had slightly poorer ability in tests of ability to make integrated movements (Jumping and Clapping).

4. Visual-motor rhythmic ability was slightly higher in the good readers than in the poor readers in grade three, but both groups were quite similar in their ability to reproduce spatially aligned designs and to draw circles simultaneously with both hands. The more uniform performances in the visual-motor area may have been due to maturity and school training, or to the lack of difficulty in the test material.

c) High grade one and high grade three group. In a comparison of performances of the high reading ability groups in grades one and three, significant differences were found between the means for the Total Rhythmic Ability Battery and the means for six of the nine sub-tests, with the grade three children showing superiority in each case. On the basis of this evidence Hypothesis Two c) is rejected.

Examination of the significant differences between the means for the high and low reading ability groups in grade three, for tests of rhythmic ability, resulted in

the following conclusions:

1. Good readers in grade three were superior to good readers in grade one in measures of rhythmic ability.
2. The greatest difference observed between the good readers in each grade was in the ability to reproduce writing patterns (Rhythmic Writing). This difference was less pronounced in the test of ability to reproduce rhythmic patterns which had a definite relationship to each other (Rhythmic Designs), although the older children appeared to be better in all tests of visual-motor ability.
3. Grade three children of high reading ability showed improvement over good readers in grade one in the ability to respond to auditory stimuli. However, the difference between the grade one and the grade three children who were good readers was less than the difference between the high and low reading groups in grade one.
4. Good readers in grade three also showed improvement over the grade one children in ability to hop in rhythmic patterns, to reproduce a series of movements (Knox Cube Imitation Test), and to repeat hand clapping patterns; the overlapping of scores indicated a wide range of behavior at each grade level.

d) Low grade one and low grade three group. In a comparison between the low reading ability groups in grades one and three, significant differences were found between the means for the Total Rhythmic Ability Battery and for seven of the rhythm sub-tests. In each instance the grade three children performed better than the grade one children. On the basis of this evidence Hypothesis Two d) is rejected.

The conclusions, drawn from the significant differences observed between the means for rhythmic ability tests for the low reading ability groups in grade one and three, were:

1. The poor readers in grade three had greatly superior rhythmic ability to the poor readers in grade one. In this sample, it seemed possible that the higher intelligence of the grade three group may have contributed to their superiority, although the relationship between intelligence and rhythmic ability was not significant at the grade three level.
2. The older children showed the greatest gains in the visual-motor abilities which were demanded in the writing of rhythmic patterns (Rhythmic Writing) and the reproduction of spatially aligned designs (Rhythmic Designs).

3. The poor readers in grade three appeared to have developed in the ability to recognize and retain patterns of sounds, and to respond to them appropriately--by either tapping a response, or matching the pattern with a visual dot pattern.
4. The ability to perform jumping, hopping, and skipping tasks and, to a lesser but significant degree, the ability to reproduce clapping patterns and sequences of movements (Knox Cube Imitation Test) showed improvement from grade one to grade three.

e) High grade one and low grade three. There was no significant difference between the means for the Total Rhythmic Ability Battery, for the groups being examined despite the difference in age and grade. However, a significant difference existed between the means for one of the rhythmic ability sub-tests (Rhythmic Writing), in favor of the grade three children. On the basis of this evidence Hypothesis 2 e) is rejected.

The following observations were made, based on a comparison of the means for rhythmic ability tests for the high reading ability group in grade one and the low reading ability group in grade three:

1. Poor readers in grade three were only slightly better than good readers in grade one in tests

of rhythmic ability which did not involve practised responses.

2. The older children were greatly superior in visual-motor tasks in which they had had training. This superiority did not seem to carry over to unfamiliar visual-motor tasks.
3. Good readers in grade one were as efficient as poor readers in grade three in responding appropriately to patterns of sounds.
4. Despite the differences in age and experience, the younger group appeared to have reached a level of development, in jumping skills and in ability to remember a sequence of movements, which was similar to the level of the poor readers in the higher grade.

<u>Hypothesis Three</u>

The relationship between rhythmic ability and reading achievement at the grade one level will not differ from the relationship observed between these abilities at the grade three level.

Examination of the intercorrelations of scores, from the <u>Total Rhythmic Ability Battery</u> and the reading tests for each grade, revealed that the correlations obtained for grade one were consistently higher than the correlations obtained for grade three. In grade one, six of the rhythmic ability sub-tests had significant

correlations with the reading ability tests; in grade three, only three of the sub-tests had consistent and positive correlations with the tests of reading ability. On the basis of this evidence Hypothesis Three is rejected.

Examination of the correlations between rhythmic ability and reading tests for the total grades disclosed the following relationships:

1. Rhythmic ability bore a closer relationship to reading achievement in grade one than in grade three.
2. Children in grade one who were efficient in dealing with patterns in one sensory-motor area tended to be efficient in other areas also.
3. In grade three, rhythmic abilities did not appear to be as closely related as in grade one. This suggested that experience, practice, training, and/or maturation had encouraged development in some areas more than others.
4. Of the rhythmic abilities examined, the auditory-motor and auditory-visual abilities were most closely related to reading achievement, both in grade one and grade three.

Hypothesis Four

There will be no significant sex differences in rhythmic ability at the grade one level or at the grade three level.

A comparison of means, for rhythmic ability tests for boys and girls in grade one, indicated that girls were superior to boys in jumping skills. Boys in grade one were better performers than girls in tests of memory for a sequence of movements. In grade three, the girls showed superior ability in jumping skills only. On the basis of this evidence Hypothesis Four is rejected.

The conclusions, based on a comparison of the means for the rhythmic ability tests, were:

1. The superiority of girls in measures of balance, which was noted at the grade one level, was still in evidence at the grade three level.
2. There was a tendency for boys in grade one to perform better than girls in tests of ability to reproduce sequences of movements. This difference was more marked between boys and girls who were good readers, than between the poor readers. Thus the ability did not appear to have any bearing on reading achievement at this grade level. The difference between boys and girls, in this ability, had disappeared at the grade three level, although a difference had been noted between good and poor readers in this grade.

LIMITATIONS OF THE FINDINGS

The findings were subject to the following limitations:

1. The evaluation of the children's performances was carried out by a single examiner, and was subject to the investigator's interpretation of the criteria set for each performance. The criteria had been examined during the pilot study, at which time changes were made to permit more objective evaluation.
2. In this study, the methods for scoring the tests <u>Circle Drawing</u>, <u>Double Circle Test</u>, and <u>Rhythmic Writing</u>, and the method for administering the tapped patterns in <u>Auditory-Motor Match</u> were not identical with the procedures outlined by the test designers (see adaptations in Appendices C and D). Direct comparisons, therefore, cannot be made between the results of the present investigation and other research in which these materials have been used.
3. This study can be regarded only as a preliminary excursion into a broad field of behavior, which may be related to reading achievement at the early levels of instruction, but which has had relatively little investigation. Problems exist

when attempting to set up controlled testing situations involving young children. Many variables--such as previous training or experience, the effect of testing at different times of the day, week, or year, personality, or emotional factors--could not be controlled or assessed in the present study. The selection and adaptation of the tests by the investigator might be open to criticism. The findings, based on the analysis of the performances by comparatively small numbers of children, must therefore be interpreted with these limitations in mind.

IMPLICATIONS FOR THE TEACHING OF READING

The conclusion, in this study, that poor readers appeared to be at a disadvantage through lack of ability to perceive or retain material which has been organized in patterns, has implications for reading instruction in the first grade and preparatory training in kindergarten. The relationship between rhythmic ability and reading achievement suggests that children who can recognize patterns, and organize their responses accordingly, appear to be more successful readers. The implication is that, if a child can comprehend that the components of a pattern such as " *** " are related differently than the components

of the pattern " ** * ", and realizes that these patterns may be expressed visually by marks, auditorily by sounds, and by motor movements, he may be better able to appreciate the stable organization of printed or written letters which represent spoken words. The ability to realize that a pattern--while representing a "whole"--is determined by the particular sequence of its parts would seem to be an aspect of readiness which may be vital to early success in reading.

Reading readiness programs recognize the importance of being able to match sounds in spoken words and letters in printed word forms. However, it is possible that many beginning readers need a preliminary step, which would include not only the matching of patterns of different kinds, but also more opportunities to translate or recode patterns from one sense to another. Through these activities, feedback would be provided by which the children could verify their impressions. Although this ability could be explored and encouraged in kindergarten and early grade one through the use of rather "non-symbolic" materials, an obvious transition would be made to experiences in matching and reproducing patterns of meaningful sounds, patterns of meaningful words, and movement patterns which translate this information into the medium of writing. An early appreciation of the importance of

pattern might be fostered through carefully planned but "informal" experiences which take into consideration the limitations of children at these age levels. Vernon has stated that young children are relatively unable to understand the "importance of order of letters in words", but that in normal readers this disappears to a large extent (1957, p. 27). Poor readers appear to retain this weakness and seem to be in need of special training which will help them cope with this problem.

The ability of children to make efficient and reliable movements, in response to various types of stimuli, seemed to have a significant effect on their poise, attitude, and on the quality of their performances. Teachers of reading should be alert to signs of motor retardation and may find that remedial procedures should begin in this area, rather than the more formal area of reading.

Another implication from the findings of this study is that grade one children, after one year of schooling, may be at a rather general level of ability to deal with patterns, and that this may be reflected in their reading and arithmetic achievement. However the older children, particularly the poor readers, presented a more uneven picture of development. The effects of success and failure and the opportunities for practice

and learning may have encouraged perception or behavior related to certain cues in the school environment, so that the older children were more able in one area than another. This suggested that "modes of learning" might be acquired, rather than innate, characteristics.

It has been mentioned that a number of children could read successfully without excelling in rhythmic ability, and that others showed evidence of the ability without notable success in reading. However, good readers on the whole performed better than poor readers. Perhaps this is not surprising; the same results may have been found in any area of behavior examined. Nevertheless, one of the observations, drawn from an examination of the records of individuals, was that young children of good ability, who did not show well-integrated rhythmic performances, might be underachieving in some areas of school work. Examples were found, in the testing program and by talking to teachers, of the bright child who had learned to read but could not get anything down on paper, and the intelligent child who could discuss ideas in abstract terms but could not cope efficiently with the printed symbols which expressed these ideas--children who had missed, as it were, sensory-motor experiences which lead to efficient movement patterns, or concrete experiences with pre-symbolic material.

It appeared, from this study, that children tend to improve and mature in the abilities which were examined. Nevertheless, the very slight differences between good readers in grade one and poor readers in grade three, except in the visual-motor area, underlines the deficiencies which may still exist in poor readers at the grade three level.

Implications for diagnosis of problems. Tests of tapped-out patterns have been found by some authorities to be of value for assessing an ability which seems to be related to reading. This ability has been variously described as ability to perceive Gestalten, memory span, attention span, or memory for temporal sequence. The findings from this study would support the use of such tests in diagnostic batteries for young children.

An implication, based on observations made in this study, is that children in the first year of school who are found to be weak in one area, are more likely to be deficient in other areas also. Therefore a weakness in the ability to reproduce patterns in one modality would lead the diagnostician or teacher to examine the child's performance when using other modalities. However, at the grade three level, the pattern of weaknesses in the low group seemed more erratic. Possibly the value of tests of rhythmic ability at this age would be to identify the

more efficient intersensory combinations and use them to support weaker modalities.

SUGGESTIONS FOR FURTHER RESEARCH

The findings, conclusions, and general observations resulting from this study have raised a number of problems which need clarification through further research. Some of these are:

1. Further investigation to determine whether training in rhythmic ability facilitates progress in reading in the beginning stages of instruction.
2. Further investigation to determine how best to evaluate children's ability to recognize and respond to patterned stimuli.
3. Further investigation of the role of auditory perception in the reading process. Slow learners are currently profiting from knowledge gained from research on visual-motor skills and visual perception. The present study would place an equal emphasis on the need for new methods for assessing and training auditory skills.
4. Investigation of readiness programs which might aid children to integrate sensory information.
5. Comparisons of rhythmic ability and reading achievement of children in the higher elementary

grades.

6. Examination of the relationship of balance and posture to speed and legibility of handwriting.
7. Examination of the relationship of auditory-motor and auditory-visual tasks to tests of ability to blend sounds.

CONCLUDING STATEMENT

The implications of this study are that certain rhythmic abilities, or pattern-making abilities, have significance for success in reading and have implications for predicting or diagnosing reading problems, and that readiness programs in kindergarten and grade one may find advantage in exploring techniques which foster these abilities.

BIBLIOGRAPHY

A. BOOKS

Bailey, J. J. The Bailey Method of Penmanship. Toronto: Sir Isaac Pitman (Canada) Ltd.

Bond, G. L. and M. A. Tinker. Reading Difficulties, Their Diagnosis and Correction. New York: Appleton-Century-Croft, Inc., 1957.

Cattell, R. B. A Guide to Mental Testing. London: University of London Press, 1936.

Clarke, H. Harrison. The Application of Measurement to Health and Physical Education. New York: Prentice-Hall Inc., 1945.

Ferguson, G. A. Statistical Analysis in Psychology and Education. New York: McGraw-Hill Book Company, Inc., 1959.

Freeman, F. N. The Teaching of Handwriting. Boston. New York: Houghton, Mifflin Co., 1914.

Gesell, A. and F. L. Ilg. The Child from Five to Ten. New York: Harper & Brothers Publishers, 1946.

Goodenough, F. L. Mental Testing. New York: Rinehart and Company, Inc., Publishers, 1949.

Harris, A. J. How to Increase Reading Ability. 3rd ed. New York: Longmans, Green and Company, 1956.

Hilgard, E. R. Introduction to Psychology. New York: Harcourt, Brace and Company, 1957.

Kephart, N. C. The Slow Learner in the Classroom. Columbus, Ohio: Charles E. Merrill Books, Inc., 1960.

Kottmeyer, W. Teacher's Guide for Remedial Reading. St. Louis: Webster Publishing Company, 1959.

Kuhlman, F. A Handbook of Mental Tests. Baltimore: Warwick & York, Inc., 1922.

Landreth, C. The Psychology of Early Childhood. New York: Alfred A. Knopf, 1958.

Lundin, R. W. An Objective Psychology of Music. New York: The Ronald Press Company, 1953.

Monroe, M. Children Who Cannot Read. Chicago: The University of Chicago Press, 1932.

Morgan, C. T. Introduction to Psychology. 2nd ed. New York: McGraw-Hill Book Company, Inc., 1961.

O'Connor, N. and B. Hermelin. Speech and Thought in Severe Subnormality. New York: Pergamon Press, 1963.

Seashore, C. E. Psychology of Music. New York: McGraw-Hill Book Company, Inc., 1938.

Stambak, M. "Three Tests of Rhythm", pp. 81-94. In Rene Zazzo, Manuel pour l'examen psychologique de l'enfant. Neuchatel (Suisse): Editions Delachaux et Niestle, 1960.

Terman, L. M. and M. A. Merrill. Measuring Intelligence. New York: Houghton Mifflin Co., 1937.

Vernon, M. D. Backwardness in Reading. Cambridge: The University Press, 1957.

Wells, F. L. and J. Ruesch. Mental Examiner's Handbook. New York: The Psychological Corporation, 1945.

B. JOURNALS AND PERIODICALS

Balow, I. H. and B. Balow. "Lateral Dominance and Reading Achievement in the Second Grade", American Education Research Journal, Vol. I, No. 3, 1964, 139-144.

Beard, R. M. "The Structure of Perception," The British Journal of Educational Psychology, XXXV Part 2, 1965.

Birch, H. G. and L. Belmont. "Lateral Dominance and Right-Left Awareness in Normal Children," Child Development, 34, 1963, 257-270.

———. "Auditory-Visual Integration in Normal and Retarded Readers," Americal Journal of Orthopsychiatry, 34, 1964, 852-861.

———. "Auditory-Visual Integration, Intelligence and Reading Ability in School Children," Perceptual and Motor Skills, 20, 1965, 295-305.

Bryant, N. D. "Characteristics of Dyslexia and Their Remedial Implication," Exceptional Children, Vol. 31, No. 4, 1964, 195-199.

Cron, G. W. and N. H. Pronko. "Development of the Sense of Balance in School Children," Journal of Educational Research, 51, 1957, 33-37.

De Hirsch, K. "Tests Designed to Discover Potential Reading Difficulties," American Journal of Orthopsychiatry, 27, 1957, 566-576.

———. "Concepts Related to Normal Reading Processes and Their Application to Reading Pathology," Journal of Genetic Psychology, 102, 1963, 277-285.

Drake, C. "Reading, 'Riting and Rhythm," The Reading Teacher, 18, 1964, 202-205.

Francis, R. J. and G. L. Rarick. "Motor Characteristics of the Mentally Retarded," American Journal of Mental Deficiency, 63, 1959, 792-811.

Hellerich, R. L. "Eye-Hand Dominance and Reading Achievement," American Education Research Journal, 1, 1964, 121-126.

Herrick, V. E. "Handwriting and Children's Writing," Elementary English, 37, 1960, 248-258. (a)

Karlin, J. E. "A Factorial Study of Auditory Function," Psychometrika, Vol. 7, No. 4, 1942.

Kephart, N. C. "Perceptual-motor Aspects of Learning Disabilities," Exceptional Children, Vol. 31, No. 4, 1964, 201-206.

McCaskill, C. L. and B. L. Wellman. "A Study of Common Motor Achievement at the Preschool Ages," Child Development, 9, 1938, 141-150.

Pflederer, M. "The Responses of Children to Musical Tasks Embodying Piaget's Principle of Conservation," Journal of Research in Music Education, 12, 1964, 251-268.

Ruchmich, C. "A Bibliography of Rhythm," The American Journal of Psychology, 24, 1913, 508-519.

———. "A Bibliography of Rhythm," The American Journal of Psychology, 29, 1918, 214-218.

Silver, A. A. "Postural and Righting Responses in Children," Journal of Pediatrics, 41, 1952.

Sloan, W. "Motor Proficiency and Intelligence," American Journal of Mental Deficiency, 55, 1950-1951, 394-406.

Smith, O. W. "Relationship of Rhythm Discrimination to Motor Rhythm Performance," Journal of Applied Psychology, 41, 1957, 365-369.

Wight, M. G. "The Effect of Training on Rhythmic Ability and Other Problems Related to Rhythm," Research Quarterly, 8, 1937, 159-172.

C. PUBLICATIONS OF UNIVERSITIES AND LEARNED SOCIETIES

Anderson, J. E. "Child Development and the Growth Process," Child Development and the Curriculum, pp. 15-49. The Thirty-Eighth Yearbook of the National Society for the Study of Education, Part 1. Bloomington, Illinois: Public School Publishing Company, 1939.

Freeman, F. N. "Language: The Development of Ability in Handwriting," Child Development and the Curriculum, pp. 255-260. The Thirty-Eighth Yearbook of the National Society for the Study of Education, Part 1. Bloomington, Illinois: Public School Publishing Company, 1939.

Goins, J. T. "Visual Perceptual Abilities and Early Reading Progress," Supplementary Education Monographs, Number 87. Chicago: The University of Chicago Press, 1958.

Guilford, J. P. "Progress in the Discovery of Intellectual Factors," pp. 261-296. Calvin W. Taylor, (ed.). Widening Horizons in Creativity. New York: John Wiley and Sons, Inc., 1964.

Herrick, V. E. Studies in Handwriting: Comparison of Practices in Handwriting Advocated by Nineteen Commercial Systems of Handwriting Instruction. Committee on Research in Basic Skills, Madison, Wisconsin: University of Wisconsin, 1960. (b)

———. (ed.). New Horizons for Research in Handwriting. Madison: University of Wisconsin Press, 1963.

Jersild, A. T. "Music," Child Development and the Curriculum, pp. 135-151. The Thirty-Eighth Yearbook of the National Society for the Study of Education, Part 1. Bloomington, Illinois: Public School Publishing Company, 1939.

———. "Education in Motor Activities," Child Development and the Curriculum, pp. 57-83. The Thirty-Eighth Yearbook of the National Society for the Study of Education, Part 1. Bloomington, Illinois: Public School Publishing Company, 1939.

Kelley, H. P. "Memory Abilities: A Factor Analysis," Psychometric Monographs 11, 1964.

Lashley, K. S. "The Problem of Serial Order in Behavior," L. A. Jeffress (ed.), Cerebral Mechanisms in Behavior; The Hixon Symposium. New York: John Wiley & Sons, Inc., 1951.

The Teaching of Handwriting. XIth. International Conference on Public Education, convened by U.N.E.S.C.O. and the I.B.E., 1948.

Williams, H. M. and C. H. Sievers. "The Measurement of Musical Development," Studies in Child Welfare Vol. VII, University of Iowa Studies. Iowa City, Iowa: Published by the University, 1932.

D. UNPUBLISHED MATERIALS

Flahtman, D. "Detroit Beginning Intelligence Test." Unpublished Study, Department of Educational Psychology, University of Alberta.

Fornwald, J. and D. Knowles. "Lorge-Thorndike Intelligence Test Study." Unpublished Study, Department of Educational Psychology, University of Alberta, 1964.

Glennon, M. B. "An Investigation of the Relationship Between Two Speeded Tests of Visual Motor Skills and a Measure of Reading Achievement." Unpublished Master's thesis, Department of Education, University of Alberta, 1961.

Godfrey, B. B. "Development of Motor Patterns for the Handicapped Pupil." Paper presented to the Adapted Physical Section Meeting of the American Association for Health, Physical Education and Recreation, Washington, D. C., May 10, 1964. (a)

________. "Development of a Motor Therapy Laboratory." Paper presented at the Summer Conference of the University of Michigan Graduate Department of Physical Education, Ann Arbor, Michigan, July 13, 1964. (b)

________. "Progress and Problems from Research on Movement, Learning, and Achievement in Children." Paper presented at the Summer Conference of the University of Michigan Graduate Department of Physical Education, Ann Arbor, Michigan, July 14, 1964. (c)

Kephart, N. C. "Perceptual Motor Survey." (Based on "A Perceptual Survey Rating Scale," Kephart, 1960.) Criteria and rating scale were received from Dr. Kephart, March 1965.

APPENDIX A : SCREENING TESTS FOR EYE DOMINANCE

SCREENING TESTS FOR EYE DOMINANCE

I. Materials

Cardboard tube; cardboard screen 9 by 11 inches with a hole ½ inch in diameter in the center; three V-shaped cones.

II. Testing Procedures

A. Test A

The child is handed the tube and is asked to look out the window using the tube as a telescope. The examiner records the eye used for sighting. (1 trial)

B. Test B

The child is asked to put the screen against his chest, holding it with both hands. At a given signal he is asked to move the card up quickly to his face and, keeping both eyes open, to look at the examiner through the hole. He is asked to tell the examiner the number of fingers she has raised in front of her face. The preferred eye for sighting is recorded. (1 trial)

C. Test C

Holding the screen at arm's length in a relaxed position, the child is asked to swing the card up and, with both eyes open, to locate the examiner. This test will be performed three times and the results will be recorded for each trial. The examiner will move to three positions at a distance of approximately ten feet from the child, one in front, one to the left, and one to the right of the child. (3 trials)

D. Test D

The child is handed a tube and is asked to sight a coin on the floor, through the tube, keeping both eyes open and holding the tube with both hands at arm's length from his face (Kottmeyer, 1957). <u>Adaptation</u>: When the coin is sighted

the child is asked to move the tube up to his face without losing sight of the coin. The examiner will record the eye (right or left) to which the tube is drawn. (1 trial)

E. Test E

At a given signal the child is asked to lift a V-shaped cone which has been placed on a chair immediately in front of him, and to place the wide end of the cone over his eyes. Keeping both eyes open he is to locate the examiner's face and count the fingers she has raised. This will permit the examiner to see which eye is being used for sighting. Three trials are given with the examiner standing in three different positions (as in Test C). After each trial the child will replace the cone on the chair so that it will be necessary for him to make new postural adjustments for each trial. (3 trials)

III. Evaluation and Scoring

The eye which is used for sighting during each trial is recorded. The child is judged to be:

1. Right-eyed, if he uses the right eye for at least eight (8) trials.
2. Left-eyed, if he uses the left eye for the first five(5) trials.
3. Inconsistent, if each eye is used for two (2) or more trials.

APPENDIX B : JUMPING TEST

JUMPING

I. Testing Procedures (modelled after Kephart, 1960)

A. Both Feet

1. Directions

Have the child stand at the side of the room where he has a clear space in front of him. Say: "Put both feet together and jump forward one step." The child must hold his feet together while he jumps and must not step forward as in walking. Permit another trial if the directions are not understood at the first presentation.

2. Evaluation Criteria

Do not give credit for the performance, if the child:

a) cannot keep both feet together, or
b) uses one side of the body only, or
c) "ties" one side of the body to the other.

3. Scoring

Give one mark if task is adequately performed.

B. Right Foot

1. Directions

Say: "Stand on your right foot (or this foot) with your left foot off the floor. Now jump forward one step." Note whether the child can shift his posture in order to operate with one side of the body only.

2. Evaluation Criteria

Credit is not given for the item if the child:

a) cannot make a smooth postural shift, or
b) cannot keep the opposite foot off the floor.

3. Scoring

Give one mark if task is performed adequately.

C. Left Foot

Directions, evaluation, and scoring are the same as for Test B, except that the child is asked to perform on his left foot.

D. Skipping

1. Directions

Say: "Now let me see you skip across the room." If the child does not use his feet alternately, ask him to do so.

2. Evaluation Criteria

Credit is not given for the item if the child:

a) cannot move freely, or
b) hesitates after each step to determine which side to use, or
c) skips in a one-sided manner.

3. Scoring

Give one mark if task is performed adequately.

E. Hopping 1/1

1. Directions

Say: "Stand with your feet together. Now hop on your right foot, lifting your left foot. Now hop on your left foot (or this foot), lifting your right foot. Hop back and forth, first on the right, then on the left."

2. Evaluation Criteria

Credit is not given for the item if the child:

a) cannot remain in one spot while hopping, or
b) cannot shift easily from side to side, or
c) is stiff and jerky in movements rather than smooth and rhythmical.

3. Scoring

Give one mark if task is performed adequately.

F. Hopping 2/2

1. Directions

Say: "Stand with your feet together. Now hop twice on your right foot and then twice (or two times) on your left foot, etc." This task is more difficult since the rhythmic patterns and alternations are not as regular. Adaptation: Demonstrate, if the task is not understood, with no comment except, "Like this."

2. Evaluation Criteria

Same as for Test E.

3. Scoring

Give one mark if task is performed adequately.

G. Hopping 2/1

1. Directions

Say: "Stand with your two feet together. Now hop twice (or two times) on your right foot, once on the left, twice on the right, etc." This is more difficult as alternations are more complicated. Adaptation: Demonstrate, if task is not understood, with no comment except, "Like this."

2. Evaluation Criteria

Same as for Test E.

3. Scoring

Give one mark if task is performed adequately.

H. Hopping 1/2

Directions, evaluation, and scoring are the same as for Test G, except that the child is asked to lead with the left foot.

II. General Comments

As this test is not being used to rate knowledge of left and right, it is permissible to point to the foot designated in the instructions, if the child appears confused. The demonstrations were introduced in Tests F, G, and H, in order to give the child every opportunity to perform these more difficult rhythmic patterns. The pilot study indicated that failure to perform these tasks might be due to lack of understanding of the directions. The total possible score for this test is 8 points.

APPENDIX C : TEST OF AUDITORY-MOTOR MATCH

TEST OF AUDITORY-MOTOR MATCH

I. Materials

Examiner's chart of rhythm patterns; screen to shield view of hand movements from the child; coins for tapping patterns; stop watch.

Tapping Patterns

Samples

1. ** (2)
2. * * (1-1)

Test Items

1. *** (3)
2. ** ** (2-2)
3. * ** (1-2)
4. * * * (1-1-1)
5. **** (4)
6. * *** (1-3)
7. ** * * (2-1-1)
8. ** ** ** (2-2-2)
9. ** *** (2-3)
10. * * * * (1-1-1-1)
11. * **** (1-4)
12. ***** (5)
13. ** * ** (2-1-2)
14. **** ** (4-2)
15. * * * ** (1-1-1-2)
16. ** *** * (2-3-1)
17. * **** ** (1-4-2)
18. ** * * ** (2-1-1-2)
19. *** * ** * (3-1-2-1)
20. * ** *** ** (1-2-3-2)
21. * ** ** * ** (1-2-2-1-2)

II. Timing

Taps are sounded with a half second pause between short intervals and a one second pause between long intervals. (Based on Birch and Belmont, 1964.)

III. Testing Procedures (adapted by investigator)

A. Directions

Using samples (1) and (2), say: "I am going to tap out some patterns. When I stop I want you to tap the same patterns." After tapping example (1) the examiner waits for the child to duplicate the pattern using a coin against the top of the table. After tapping example (2) the examiner says: "That was a slow one." If the child does not understand what he is to do, repeat the instructions and demonstration, using the same examples.

The examiner will erect a small screen which hides his hand movements from view, and will proceed with test items 1-21, saying: "Listen, and then tap."

B. The incorrect patterns, which are tapped by the child, and the more complicated tapping patterns should be recorded in the test booklet, using numbers to indicate how the taps were grouped (2-1-1). The rate of the child's tapping need not match the examiner's, but the pattern must be clearly indicated.

C. One mark is given for each completely correct pattern which follows a single presentation by the examiner. The total possible score is 21 points.

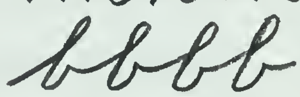
APPENDIX D : TESTS OF VISUAL-MOTOR MATCH

TESTS OF VISUAL-MOTOR MATCH

I. Materials

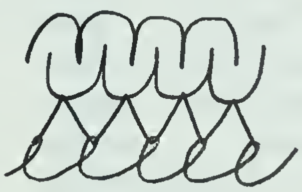
Chalkboard easel approximately five feet by four feet; chalk; a copy of rhythmic writing patterns (motifs); a copy of rhythmic designs.

Motifs

1. 
2. 
3. 
4. 
5. 
6. 

Rhythmic Designs

1.
2.
3.
4.



II. Testing Procedures

A. Circle Drawing (adapted from Kephart, 1960)

1. Directions

Say: "Go to the chalkboard and draw a circle." Give no other directions. If the child queries the instructions, say: "Make it like you think it should be." The circle is evaluated according to the criteria given below, and then erased. If the child draws a circle which is markedly too small (less than 18-24 inches in diameter), ask him to make a larger one. Repeat the instructions until he makes one the required size. Adaptation: The child is asked to draw a total of three circles. Each circle is evaluated and erased before the next one is drawn. Instructions for making the second and third circles may include verbal suggestions concerning the size and/or shape.

2. Evaluation and Scoring

Each of the three circles is marked out of a total of four points. One mark is given for each of the following:

a) proper size (between 18 and 24 inches in diameter;
b) accuracy of shape;
c) correct position of drawing with reference to the midline of the body;
d) direction of drawing (counter-clockwise for right-handed children).

The total possible score is 12 points.

B. Double Circle Test (adapted from Kephart, 1960)

1. Directions

Say: "Now take a piece of chalk in each hand and draw two circles at the same time, one with the right hand and one with the left hand." The task is not to be demonstrated or described, but if the drawings are too small the child is asked to erase them and make them larger.
Adaptation: The child is given three trials. Each trial is evaluated and marked according to the criteria given below.

2. Evaluation and Scoring

The method of scoring was devised by the present investigator, based on criteria given by Kephart. Each set of drawings (3 sets) may receive a total of 4 points. One mark is given for each of the following:

a) proper size (diameters of each circle in the pair to be between 18 to 24 inches);
b) correct position of the drawings with reference to each other--not too wide apart or overlapping;
c) correct direction of drawings--the circle on the right drawn in a counter-clockwise movement, and the one on the left in a clockwise movement;
d) the relative accuracy of shape--not flattened.

The total possible score is 12 points.

C. Rhythmic Writing (adapted from Kephart, 1965)

1. Directions

The child is asked to turn away from the chalkboard while the examiner puts the motif on the left side of the board. He is asked to turn back to the board and the examiner says: "Now make a design like mine on your side of the chalkboard." The child is permitted three trials on each pattern but if the first performance is satisfactory in both rhythm and reproduction, the examiner will proceed to the next pattern. The model is left on the board until the trials for that pattern are completed; however each trial is erased after it has been evaluated. The child is not allowed to watch the examiner as he puts the model on the board. The examiner may make one additional comment as the trials progress: "Is your design just like mine?"

2. Evaluation and Scoring

The method of scoring was devised by the present investigator, based on criteria given by Kephart, 1965. Kephart evaluates the writing according to rhythm, reproduction, and orientation. Only the first two criteria are used formally in this study.

Each pattern may receive a total of 2 marks--one for a satisfactory rhythmic performance, and one for satisfactory reproduction--making a total possible score of 12 points for the complete test. Credit is not given for rhythm if the movement is:

a) hesitant and jerky,
b) cramped and inflexible,
c) not constant.

This is interpreted to mean that the writing is rhythmic if the child reproduces the pattern by repeating similar patterns of movements in a consistent manner, using arm movements rather than finger movements. Credit is not given for rhythm if the reproduction is not

correct. However a performance may be non-rhythmic and receive a mark for correct reproduction. Credit is not given for reproduction if:

a) the design is incorrect (omissions, inaccuracies),
b) the size is not reasonably constant.

If the child starts a design and then erases it, this is considered as one trial.

If a rhythmic performance is achieved on any one of the three trials, the child receives full marks (1) for rhythm for that pattern. One-half mark (½) is given for a fairly adequate rhythmic performance. The total possible score for rhythm is 6 points.

A pattern which is reproduced accurately on the first trial will receive one mark (1). If the reproduction is satisfactory on the second or third trial, one-half mark (½) is given. The total possible score for reproduction is 6 points.

D. Rhythmic Designs

1. Directions

The child turns away while the examiner puts the first pattern on the left side of the chalkboard. The child turns to face the board and the examiner says: "Now make a design like mine on your side of the board." When the child has completed his pattern it is left on the board. He turns away again while pattern (2) is added to the design. This is repeated until the design consists of four patterns. No comments are made concerning the performance.

2. Evaluation and Scoring

Each pattern is evaluated as soon as it has been completed. If the pattern is reproduced correctly in a smooth, consistent manner, one mark (1) is given for rhythm. If the pattern is correctly aligned with the preceding

pattern, one mark (1) is given for spacing. The total possible score is 7--four marks for rhythm and three marks for spacing.

APPENDIX E : TEST OF AUDITORY-VISUAL INTEGRATION

KNOX CUBE IMITATION TEST

CLAPPING TEST

TEST OF AUDITORY-VISUAL INTEGRATION

I. Materials

Coin for tapping patterns, chart of auditory tap patterns*, sheet with visual dot patterns*, 2 pieces of cardboard to cover dot patterns.
Adaptation: Rather than tapping the patterns with a pencil against the edge of the table (Birch and Belmont, 1964), the edge of a coin is used against the top of the table. The test designers had used two devices for concealing the visual dot patterns: (1) a stencil with a slot (1964), and (2) individual cards for each multiple choice item (1965). The present investigator used two pieces of cardboard, one held in position by the child, which underlined the patterns to be examined, and one moved by the examiner (after she had tapped the pattern) to expose the multiple choice item required.

II. Testing Procedures (based on Birch and Belmont, 1964)

A. Directions

The examiner sits facing the child. The visual dot patterns are to be covered with the two pieces of cardboard during the auditory presentation. Taps are made with a half second (½) pause between the short intervals, and a one second (1) pause between the long intervals. After the tapping pattern has been presented, the appropriate row, with three patterns to choose from, will be exposed. The child points to the matching visual pattern. The verbal instructions will correspond exactly to the directions outlined by Birch and Belmont (1964), with the following addition: the three examples may be repeated, using the same directions, if the child appears confused (indicated by errors). Following the repetition, whether or not errors have been made, the test items are presented with no comment except that which is permitted in the instructions.

*Auditory and visual patterns taken from Birch and Belmont (1964).

B. Evaluation and Scoring

Accept only first choices. One mark (1) is given for each correct response. The total possible score is 10 points.

KNOX CUBE IMITATION TEST
(Pintner's Modification)

I. Materials

Five one inch cubes; chart of patterns to be tapped.

Test Patterns

A.	1234	E.	13243
X.	12343	F.	14324
Y.	12342	G.	13124
B.	1324	H.	143124
C.	1432	I.	132413
D.	1423	J.	142341

This order is Pintner's modification and extension of Knox's test. X and Y follow on A as shown; thereafter proceed alphabetically.

II. Timing

The taps are made at the rate of one per second.

III. Testing Procedures

A. Directions

Four of the blocks are placed about two inches apart, in a row in front of the child. The examiner, holding the fifth block in her hand, says: "Watch carefully, and then do as I do." She taps the blocks with the fifth block in the prescribed order (one tap per second), always beginning with the cube at the subject's left. She then lays the fifth block down in front of the child between the third and fourth blocks, and says: "Do that." All of the twelve patterns presented are test items.

B. Evaluation and Scoring

One mark (1) is given for each completely correct pattern which is tapped following a single presentation by the examiner. The rate of the child's tapping need not match that of the examiner's. The total possible score is 12.

CLAPPING

I. Materials

Chart with clapping patterns.

Patterns

1. /// /// ///

2. / / /// / / ///

3. // // // (accent on the second clap of each pair)

4. /// / /// /

5. Clapping in time to "Hickory-Dickory Dock"

II. Testing Procedures

A. Directions

Say: "Listen, while I clap a pattern. When I finish, you clap the same pattern." The examiner claps pattern 1. and then the child claps this rhythm. Patterns 2., 3., and 4., are presented in the same manner. Then the examiner will say: "I want you to say "Hickory-Dickory Dock", and, in case you have forgotten it, I will say it with you. While we are saying it, I want you to keep time by clapping."

B. Evaluation and Scoring

One mark (1) is given for each pattern correctly clapped. The child may extend the pattern in items 1., 2., 3., and 4. In item 5. the child will get credit for either a simple or complex pattern providing that he keeps accurate time with the 'beat' of the verse. The total possible score is 5.